

TURLOCK IRRIGATION DISTRICT

2025 AGRICULTURAL WATER MANAGEMENT PLAN

INITIAL DRAFT

Prepared by:

Turlock Irrigation District
333 E. Canal Drive
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February 2026

Prepared for compliance with:

The Water Conservation Act of 2009 (Senate Bill x7-7) and the 2018 Water Conservation Legislation (Assembly Bill 1668 and Senate Bill 606)

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Preface

This Agricultural Water Management Plan (AWMP or Plan) has been prepared by Turlock Irrigation District (TID or District) in accordance with the requirements of the 2009 Water Conservation Act (SBx7-7) and the 2018 Water Conservation Legislation (AB 1668 and SB 606). TID supplies agricultural water to more than 130,000 acres and is therefore required by California law to adopt and implement an AWMP and submit the AWMP to the California Department of Water Resources (DWR).

SBx7-7 modified Division 6 of the California Water Code (CWC or Code), adding Part 2.55 (commencing with §10608) and replacing Part 2.8 (commencing with §10800). In particular, SBx7-7 requires all agricultural water suppliers to prepare and adopt an update to their AWMP as set forth in the CWC and the California Code of Regulations (CCR) on or before December 31, 2015. The Plan must be updated every 5 years thereafter (§10820 (a)). Additionally, the CWC requires suppliers to implement certain efficient water management practices (EWMPs).

The 2018 Water Conservation Legislation (AB 1668 and SB 606) updated the 2009 Water Management Planning Act to provide more information and analysis regarding the agricultural water supplier's system management and evaluation.

This Plan is the 5-year update to the TID AWMP, last adopted and submitted to DWR in 2020 in accordance with SBx7-7. This update to the AWMP has been adopted before the April 1, 2026 deadline and has been electronically submitted to DWR no later than 30 days after adoption.

The main resources used to develop this 2025 Plan were the CWC itself, the 2025 Agricultural Water Management Guidebook, and the relevant sections of the CCR. A cross-reference is provided on the following pages that identifies the location(s) in the AWMP within which each of the applicable requirements of SBx7-7 and the corresponding sections of the CWC and CCR are addressed. This cross-reference is intended to support efficient review of the AWMP to verify compliance with the Law.

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AWMP Checklist

Cross Reference Table of Turlock Irrigation District 2025 Agricultural Water Management Plan to Relevant Sections of the California Water Code

AWMP Section	Guidebook Location	Description	Water Code Section (or as identified)
Preface	1.4	AWMP Required	10820, 10608.12
Preface; 2.1	1.4	At least 25,000 irrigated acres	10853
N/A	1.4	10,000 to 25,000 acres and funding provided	10853
Preface; 1.3.1	1.4	April 1, 2026 update	10820 (a)
Preface; 1.3.2	1.4 A.2	Added to the Water Code: <u>Added to the Water Code: AWMP submitted to DWR no later than 30 days after adoption; AWMP submitted electronically</u>	New to the Water Code: <u>10820(a)(2)(B)</u>
Preface	1.4 B	5-year cycle update	10820(a)
N/A	1.4 B	New agricultural water supplier after December 31, 2012 - AWMP prepared and adopted within 1 year	10820(b)
N/A	1.6, 5	USBR water management/conservation plan:	10828(a)
N/A	1.6, 5.1	Adopted and submitted to USBR within the previous four years, AND	10828(a)(1)
N/A	1.6, 5.1	The USBR has accepted the water management/conservation plan as adequate	10828(a)(2)
N/A	1.4 B	UWMP or participation in area wide, regional, watershed, or basin wide water management planning: does the plan meet requirements of SB X7-7 2.8	10829
1.1	3.1 A	Description of previous water management activities	10826(d)
1.2.2; Table 1.1; Appendix A	3.1 B.1	Was each city or county within which supplier provides water supplies notified that the agricultural water supplier will be preparing or amending a plan?	10821(a)
1.2.2; 1.3.3; Table 1.1; Appendix A	3.2 B.2	Was the proposed plan available for public inspection prior to plan adoption?	10841
1.2.2; Table 1.1; Appendix A	3.1 B.2	Publicly-owned supplier: Prior to the hearing, was the notice of the time and place of hearing published within the jurisdiction of the publicly owned agricultural water supplier in accordance with Government Code 6066?	10841
1.2.2; Table 1.1; Appendix A	3.1 B.2	14 days notification for public hearing	GC 6066
1.2.2; Table 1.1; Appendix A	3.1 B.2	Two publications in newspaper within those 14 days	GC 6066
1.2.2; Table 1.1; Appendix A	3.1 B.2	At least 5 days between publications? (not including publication date)	GC 6066

AWMP CHECKLIST

AWMP Section	Guidebook Location	Description	Water Code Section (or as identified)
N/A	3.1 B.2	Privately-owned supplier: was equivalent notice within its service area and reasonably equivalent opportunity that would otherwise be afforded through a public hearing process provided?	10841
1.3.1; Appendix A; Table 1.1	3.1 C.1	After hearing/equivalent notice, was the plan adopted as prepared or as modified during or after the hearing?	10841
1.3.2; Table 1.1; Appendix A	3.1 C.2	Was a copy of the AWMP, amendments, or changes, submitted to the entities below, no later than 30 days after the adoption?	10843(a)
1.3.2; Table 1.1; Appendix A	3.1 C.2	The department.	10843(b)(1)
1.3.3; Table 1.1; Appendix A	3.1 C.2	Any city, county, or city and county within which the agricultural water supplier provides water supplies.	10843(b)(2)
1.3.3; Table 1.1; Appendix A	3.1 C.2	Any groundwater management entity within which jurisdiction the agricultural water supplier extracts or provides water supplies.	10843(b)(3)
1.3.2; 1.3.3; Table 1.1; Appendix A	3.1 C.3	Adopted AWMP availability	10844
1.3.3; Table 1.1; Appendix A	3.1 C.3	Was the AWMP available for public review on the agricultural water supplier's Internet Web site within 30 days of adoption?	10844(a)
1.3.2; Table 1.1; Appendix A	3.1 C.3	If no Internet Web site, was an electronic copy of the AWMP submitted to DWR within 30 days of adoption?	10844(b)
1.4	3.1 D.1	Implement the AWMP in accordance with the schedule set forth in its plan, as determined by the governing body of the agricultural water supplier.	10842
2	3.3	Description of the agricultural water supplier and service area including:	10826(a)
2.1.1	3.3 A.1	Size of the service area.	10826(a)(1)
2.1.2; Appendix D	3.3 A.2	Location of the service area and its water management facilities.	10826(a)(2)
2.1.3	3.3 A.3	Terrain and soils.	10826(a)(3)
2.1.4	3.3 A.4	Climate.	10826(a)(4)
2.2.1	3.3 B.1	Operating rules and regulations.	10826(a)(5)
2.2.2; Appendix F	3.3 B.2	Water delivery measurements or calculations.	10826(a)(6)
2.2.3	3.3 B.3	Water rate schedules and billing.	10826(a)(7)
2.2.4; Appendix G	3.3 B.4	Water shortage allocation policies and detailed drought plan	10826(a)(8) 10826.2
3	3.4	Water uses within the service area, including all of the following:	10826(b)(5)
3.1	3.4 A	Agricultural.	10826(b)(5)(A)

AWMP CHECKLIST

AWMP Section	Guidebook Location	Description	Water Code Section (or as identified)
3.2	3.4 B	Environmental.	10826(b)(5)(B)
3.3	3.4 C	Recreational.	10826(b)(5)(C)
3.4	3.4 D	Municipal and industrial.	10826(b)(5)(D)
3.5	3.4 E	Groundwater recharge, including estimated flows from deep percolation from irrigation and seepage	10826(b)(5)(E)
4.1	3.5 A	Description of the quantity of agricultural water supplier's supplies as:	10826(b)
4.1.1	3.5 A.1	Surface water supply.	10826(b)(1)
4.1.2	3.5 A.2	Groundwater supply.	10826(b)(2)
4.1.3	3.5 A.3	Other water supplies, including recycled water	10826(b)(3)
2.2.1.4; 4.2.3; 5.5; Table 5.3 (spillage); Table 5.4 (tailwater/tilewater to rivers)	3.5 A.4	Drainage from the water supplier's service area.	10826(b)(6)
4.2	3.5 B	Description of the quality of agricultural waters supplier's supplies as:	10826(b)
4.2.1	3.5 B.1	Surface water supply.	10826(b)(1)
4.2.2	3.5 B.2	Groundwater supply.	10826(b)(2)
4.2.3; 4.2.4; 4.2.5; 4.2.6	3.5 B.3	Other water supplies.	10826(b)(3)
4.2.7	3.5 C	Source water quality monitoring practices.	10826(b)(4)
Appendix H (water year); Section 5.5 (irrigation season); Sections 5.2 through 5.4 (supporting info)	3.6	Added to Water Code: Annual water budget based on the quantification of all inflow and outflow components for the service area.	Added to Water Code 10826(c)
5.7	3.7 C	Added to Water Code: Identify water management objectives based on water budget to improve water system efficiency	Added to Water Code 10826(f)
5.8; Table 5.6; Table 5.7	3.8 D	Added to Water Code Quantify the efficiency of agricultural water use	Added to Water Code 10826(h)
6	3.9	Analysis of climate change effect on future water supplies analysis	10826(d)
5.8; 7	4	Water use efficiency	10826(e)
7		Information required pursuant to § 10608.48.	
7; 7.5; Table 7.1; Table 7.4	4.1	Implement efficient water management practices (EWMPs)	10608.48(a)
7.2; 7.5; Appendix F	4.1 A	Implement Critical EWMP: Measure the volume of water delivered to customers with sufficient accuracy to comply with subdivision (a) of §531.10 and to implement paragraph (2).	10608.48(b)

AWMP CHECKLIST

AWMP Section	Guidebook Location	Description	Water Code Section (or as identified)
7.3; 7.5	4.1 A	Implement Critical EWMP: Adopt a pricing structure for water customers based at least in part on quantity delivered.	10608.48(b)
7.4; 7.5	4.1 B	Implement additional locally cost-effective and technically feasible EWMPs	10608.48(c)
7.4; 7.5; Table 7.1	4.1 C	If applicable, document (in the report) the determination that EWMPs are not locally cost-effective or technically feasible	10608.48(d)
7.4; 7.5; Table 7.1	4.1 C	Include a report on which EWMPs have been implemented and planned to be implemented	10608.48(d)
7.6; Table 7.5	4.1 C	Include (in the report) an estimate of the water use efficiency improvements that have occurred since the last report, and an estimate of the water use efficiency improvements estimated to occur five and 10 years in the future.	10608.48(d)
N/A	5	USBR water management/conservation plan may meet requirements for EWMPs	10608.48(f)
N/A	6 A	Lack of legal access certification (if water measuring not at farm gate or delivery point)	CCR§597.3(b)(2)(A)
N/A	6 B	Lack of technical feasibility (if water measuring not at farm gate or delivery point)	CCR§597.3(b)(1)(B), §597.3(b)(2)(B)
N/A	6 A, 6 B	Delivery apportioning methodology (if water measuring not at farm gate or delivery point)	CCR§597.3(b)(2)(C)
Appendix F (Section 4)	6 C	Description of water measurement BPP	CCR §597.4(e)(2)
Appendix F (Section 4.5)	6 D	Conversion to measurement to volume	CCR §597.4(e)(3)
Appendix F (Section 7; Attachment F.1)	6 E	Existing water measurement device corrective action plan? (if applicable, including schedule, budget and finance plan)	CCR §597.4(e)(4)

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List of Acronyms

ACOE.....	Army Corps of Engineers
ACWA	Association of California Water Agencies
Ac	acre
AF	acre-feet
APAP	Aquatic Pesticide Application Plan
ARSS.....	Airborne Remote Sensing for Snowpack
ASCE	American Society of Civil Engineers
AWMC.....	Agricultural Water Management Council
AWMP	Agricultural Water Management Plan
BCSD	Bias Comparison and Spatial Disaggregation
CASGEM.....	California Statewide Groundwater Elevation Monitoring
CCR.....	California Code of Regulations
CCUF	Crop Consumptive Use Fraction
CDEC.....	California Data Exchange Center
CEQA.....	California Environmental Quality Act
cfs.....	cubic feet per second
CFWC	California Farm Water Coalition
CIMIS	California Irrigation Management Information System
CMIP3.....	Coupled Model Intercomparison Project Phase 3
CMUA.....	California Municipal Utilities Association
CN	Curve number
CV-GMC.....	Central Valley Groundwater Monitoring Collaborative
CV-SALTS	Central Valley Salinity Alternatives for Long-term Sustainability
CWC	California Water Code
DF	Delivery Fraction
DMP	Drought Management Plan

Glossary of Terms

DO.....	Dissolved Oxygen
DP _{aw}	Deep percolation of applied water
DP _{pr}	Deep percolation of precipitation
DWR	Department of Water Resources
EC	Electrical Conductivity
ESJWQC	East San Joaquin Water Quality Coalition
ESRIRWMP.....	East Stanislaus Region Integrated Regional Water Management Plan
ET	Evapotranspiration
ET _a	Actual Evapotranspiration
ET _{aw}	Evapotranspiration of applied water
ET _c	Crop evapotranspiration
ET _o	Reference evapotranspiration
ET _{pr}	Evapotranspiration of precipitation
EWMP.....	Efficient Water Management Practice
FAO.....	Food and Agriculture Organization
FC.....	Field capacity
F-CO	Forecast-Coordinated Operations
FERC.....	Federal Energy Regulatory Commission
FIRO	Forecast Informed Reservoir Operations
GAR.....	Groundwater Assessment Report
GCMs.....	Global Climate Models
GDD.....	growing degree day
GRAT.....	Groundwater Recharge Assessment Tool
GSA.....	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
GWMP	Groundwater Management Plan
ID	Improvement District
IDC.....	Integrated Water Flow Model Demand Calculator

Glossary of Terms

IFMP	Irrigation Facilities Master Plan
ILRP	Irrigated Lands Regulatory Program
ITRC	Irrigation Training and Research Center
JPL	Jet Propulsion Laboratory
K_{sat}	Saturated hydraulic conductivity
LGA	Local Groundwater Assistance
M&I.....	Municipal and Industrial
METRIC	Mapping Evapotranspiration at High Resolution using Internalized Calibration
MID.....	Modesto Irrigation District
MOU	Memorandum of Understanding
NASA.....	National Aeronautics and Space Administration
NCSS.....	National Cooperative Soil Survey
NIST.....	National Institute of Standards and Technology
NIWR	Net Irrigation Water Requirements
NMP.....	Nitrogen Management Plan
NOAA.....	National Oceanic and Atmospheric Administration
NPDES.....	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
ppm	parts per million
PU608	Planning Unit 608
PWP	Permanent wilting point
RWQCB.....	Regional Water Quality Control Board
SBx7-7	Water Conservation Act of 2009
SCADA.....	Supervisory Control and Data Acquisition
SCS	Soil Conservation Service
SEBAL.....	Surface Energy Balance Algorithm for Land
SGMA.....	Sustainable Groundwater Management Act
SJTA	San Joaquin Tributaries Authority

Glossary of Terms

SRWA.....	Stanislaus Regional Water Authority
SSURGO	Soil Survey Geographic database
SWRCB.....	State Water Resources Control Board
TCC.....	Total Channel Control
TDS.....	Total Dissolved Solids
TGBA.....	Turlock Groundwater Basin Association
TID.....	Turlock Irrigation District
TKN	Total Kjeldahl Nitrogen
TOC.....	Total Organic Carbon
USBR.....	United States Bureau of Reclamation
USDA.....	United States Department of Agriculture
USCID.....	United States Committee for Irrigation and Drainage
VAMP	Vernalis Adaptive Management Plan
WCRP	World Climate Research Program
WDO.....	Water Distribution Operator
WDR	Waste Discharge Requirements
WMF	Water Management Fraction
WMP	Water Master Plan
WTSGSA	West Turlock Subbasin Groundwater Sustainability Agency
WUE	Water Use Efficiency
WWCRA.....	West-Wide Climate Risk Assessment

Glossary of Terms

Acre-Foot	The volume of water required to cover one acre of land one foot deep. Equal to 325,900 gallons.
Assessed Acres	Total acres, as determined by the county assessor’s office, for parcels that receive irrigation water. This acreage includes developed (non-irrigated) portions of the parcels such as roads, buildings and ditches.
Conjunctive Use	Using a combination of surface water and groundwater supplies to meet water demands.
Conjunctive Management	Coordinating operation and monitoring of surface water and groundwater supplies to meet defined objectives.
Evapotranspiration	The loss of water, to the atmosphere, by the combined processes of evaporation (from soil and plant surfaces) and transpiration (from plant tissues).
Gardenhead	A parcel (hobby farm) that is five acres or less, irrigates on a pre-set rotational group schedule, and grows small pastures, lawns, ornamentals, or produce for self-consumption.
Gross Acres	All lands within the irrigation service boundary such as cities, agricultural lands, roads and lake acreage.
Improvement District	An Improvement District (ID) is a mechanism that allows a group of growers to pool resources to construct irrigation facilities. IDs can be formed for a variety of reasons, such as constructing, operating, and maintaining ditches, pipes, and wells, as well as surface and subsurface drains. TID administers the improvement districts.
Irrigable Acres	All lands that could be irrigated within the irrigation service boundary. This designation includes both lands that are currently irrigated and lands that are not currently being irrigated but have access to irrigation water through an active irrigation service connection.
Irrigated Acres	An estimate of the actual amount of land surface to which irrigation water is being applied. A survey performed in the 1990’s found that approximately six percent of assessed acres are non-productive lands such as roads, buildings and ditches. Therefore, the Assessed Acres have been reduced by six percent to arrive at the Irrigated Acres.
Private Pumping	Groundwater pumping by growers or Improvement Districts using privately-owned wells. Private pumping is often used to supplement irrigation water supplied by TID.

Glossary of Terms

Rented Pumping.....Groundwater pumping by TID using rented pumps that are owned by private parties or Improvement Districts. TID rents pumps to supplement other irrigation water supplies.

Turlock Subbasin.....The groundwater subbasin underlying the eastern portion of the San Joaquin Valley bounded by the Tuolumne River to the north and the Merced River to the south. The western and eastern boundaries of the groundwater subbasin are the San Joaquin River and the Sierra Nevada foothills, respectively. (California Department of Water Resources, 2006).

Executive Summary

INTRODUCTION

The Turlock Irrigation District (TID, or District) has prepared this Agricultural Water Management Plan (AWMP or Plan) to fulfill the requirements of the 2009 Water Conservation Act (SBx7-7) and the 2018 Water Conservation Legislation (AB 1668 and SB 606).

TID understands that the intent of SBx7-7 and the 2018 Water Conservation Legislation is to encourage water suppliers to evaluate their water management operations and to implement locally cost-effective efficient water management practices (EWMPs) that improve the efficient use of irrigation water. In developing this Plan, TID has devoted considerable effort to evaluating ongoing and planned water management efforts. TID is committed to sustaining sound water management practices where they are already in place and to improving practices that can be strengthened.

This 2025 AWMP has been updated with all required elements described in the Agricultural Water Management Planning regulations. The AWMP Checklist included at the beginning of this plan provides a cross-reference between the sections of this AWMP and relevant sections of the California Water Code.

TID'S WATER SUPPLIES AND CONJUNCTIVE MANAGEMENT PERSPECTIVE

A key point highlighted by this AWMP is the District's conjunctive management of both surface water and groundwater supply sources. The water balance developed as part of the AWMP shows that, on average, approximately 80 percent of the water supply in TID comes from surface sources, with the remainder coming primarily from groundwater (approximately 18%) with a relatively smaller volume of other supplies (approximately 2%)¹. The computations performed for the water balance and presented throughout the Plan are based on water usage during the period 2020-2024 (near-term historical period) and 2014-2024 (long-term historical period). The 11-year long-term historical period encompasses 5 years of normal water supplies and 6 years of reduced water supplies (as characterized based on annual water supplies available from TID to growers) and illustrates how TID shifts between groundwater and surface water supply sources in response to hydrologic conditions. Through pricing, policies, and practices, the District encourages the use of surface water for crop production when it is available to reduce reliance on groundwater and to maintain long-term water supply reliability.

TID's conjunctive management provides a significant amount of recharge to the Turlock Subbasin (or Subbasin). The water balance, as described in **Section 5** (calendar year water balance) and **Appendix H** (water year water balance), quantifies the various inflows and

¹ Surface water supply is comprised of irrigation releases from Turlock Lake. Groundwater supply is comprised of TID drainage pumping, TID rented pumping, and private pumping. Other water supplies include treated wastewater, spill recovery, and tailwater, tilewater, and runoff that flow to TID canals.

outflows within the District's service area. Between 2014-2024, the average net recharge² to the Subbasin from TID's conjunctive management practices ranged from approximately 0.04 acre-feet per acre (AF/ac) in dry years to 1.31 AF/ac in normal years.³ This recharge has helped TID and its customers to achieve a generally consistent and reliable water supply in all but the most severe droughts, enabling growers to meet crop requirements through pumping in drier years to make up for reduced surface water supplies.

Recent drought conditions reemphasize the importance of recharge from surface water supplies to achieve groundwater sustainability in the Turlock Subbasin, as envisioned by the Sustainable Groundwater Management Act of 2014 (SGMA). Past analyses have shown that seepage and deep percolation of a portion of TID's surface water supply serves as the primary source of recharge to the groundwater system. Thus, while groundwater provides a significant portion of the water used by the District and others within the Turlock Subbasin, much of this groundwater is derived from management of surface water resources by TID and its irrigation customers.

Conjunctive management is promoted primarily through TID's pricing policies and operating practices. These actions help support sustainable agricultural production within TID. In addition, the benefits of TID's conjunctive management policies extend to municipal users within the District and to agricultural users outside of TID's boundaries for whom groundwater is the only source of supply.

Surface water supplies are a crucial component of the District's conjunctive use program. Water supplies and reservoir management are bolstered by airborne remote sensing of the snowpack within the Tuolumne River watershed, forecast-coordinated operations (F-CO), and cloud seeding, enabling the District to better manage surface water supplies, both in times of surplus and times of shortage.

Because of the long-term supply reliability offered by access to both surface water and groundwater as sources of supply, TID will continue to pursue conjunctive management through its own water management practices. As a member of the West Turlock Subbasin Groundwater Sustainability Agency (WTSGSA), TID will also continue to work with other agencies and stakeholders within the Turlock Subbasin to comply with SGMA. TID and other agencies in the Subbasin are already working together to develop the tools needed to achieve long-term groundwater sustainability by identifying additional ways to maximize local water supplies, enhance conjunctive management practices, and recharge the groundwater system.

IMPLEMENTATION OF EFFICIENT WATER MANAGEMENT PRACTICES

The CWC §10608.48 describes sixteen (16) efficient water management practices (EWMPs) covering the specific mechanisms for promoting improved water management. The CWC lists two types of EWMPs: two (2) critical EWMPs that are mandatory for all agricultural water

² Net recharge is calculated as the total groundwater recharge (seepage and deep percolation) minus the total groundwater extraction, divided by the total irrigated area. The volume of groundwater recharge from deep percolation of precipitation includes both irrigation season and off-season recharge. All other recharge and extraction is summarized over the irrigation season.

³ These values are calculated for the TID system downstream of Turlock Lake, and as such, do not include recharge from Turlock Lake or seepage from the canal system upstream of Turlock Lake.

suppliers subject to the Code, and fourteen (14) conditional EWMPs that are mandatory if found to be technically feasible and locally cost-effective based on conditions within TID.

The TID AWMP evaluates and describes TID's current implementation of these EWMPs. **Table ES.1** of this Executive Summary summarizes the status of EWMP implementation for each of the EWMPs. TID has implemented and continues to implement all technically feasible EWMPs at a locally cost-effective level.

CONCLUSION

This update to the TID AWMP has provided the District with an opportunity to reexamine its water management practices and to evaluate how these practices support the District's goals to provide reliable and high-quality water supplies to its irrigation customers. The Plan demonstrates the critical importance of TID's overall conjunctive management strategy to meeting these goals and responding to evolving customer needs. As demonstrated in this Plan, the District is committed to ongoing evaluation and implementation of EWMPs at locally cost-effective levels in support of TID goals while also complying with all Agricultural Water Management Planning regulations.

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Table ES.1. Summary of TID Implementation Status for EWMPs Listed Under CWC 10608.48(b) & (c).

Water Code Reference No.	EWMP	Implemented Activities (pre-2020 and ongoing)	Updates Since Last AWMP (2020-2025)	Planned Activities
Critical EWMPs				
10608.48.b(1)	Measure deliveries with sufficient accuracy	Initiated delivery measurement accuracy improvement program under a corrective action plan for SBx7-7 compliance: - Installed new permanent measurement devices with laboratory-certified flow rate accuracy at 142 sidegates serving roughly half the irrigated acreage in TID. - Developed calibrated flow rates at remaining sidegates for each specific combination of sidegate-parcel-irrigation method-requested flow rate: - Temporarily installed 129 mobile Rubicon FlumeMeters at 550 sidegates that serve 1,196 parcels (representing approximately 21 percent of TID) - Used Hach FH950 meters to determine parcel-specific calibrated flow rates at 349 sidegates serving 536 parcels (approximately 13 percent of TID) - Used Fuji Portaflow meters to determine parcel-specific calibrated flow rates at 471 sidegates serving 877 parcels (approximately 19 percent of TID) - Completed initial corrective action plan goals, providing direct measurements or calibrated delivery flow rates to 100% of the assessed acreage served by active, non-exempted sidegates - Updated water ordering, delivery, and billing software to use the measured and calibrated flow rates for billing. - Used updated values to calculate the measured volume of water delivered for reporting to DWR. - Conducted a formal certification of the volumetric measurement accuracy consistent with 23 CCR §597. - Verified accuracy of new permanent measurement devices. - Verified accuracy of existing measurement devices (progress delayed due to operational challenges associated with COVID-19)	- Completed the last remaining actions needed for formal certification of the volumetric measurement accuracy of existing measurement devices, consistent with 23 CCR §597. - Verified accuracy of existing measurement devices that had not yet been field-tested and certified. - Continued using the measured and calibrated flow rates for billing. - Continued using the measured and calibrated flow rates to calculate the measured volume of water delivered for reporting to DWR. - Continued flow rate calibrations in response to evolving needs of customers. - Considering additional permanent measurement devices when funding is available and where it provides benefits (e.g., measurement accuracy and/or customer service improvements).	- Continue using the measured and calibrated flow rates for billing. - Continue using the measured and calibrated flow rates to calculate the measured volume of water delivered for reporting to DWR. - Continue flow rate calibrations in response to evolving needs of customers. - Consider additional permanent measurement devices when funding is available and where it provides benefits (e.g., measurement accuracy and/or customer service improvements).
10608.48.b(2)	Adopt a water pricing structure based in part on quantity delivered	Tiered pricing structure based on volume of water delivered (in effect since 2013; current rate structure in effect since 2015 after completion of the Proposition 218 process) Updated water ordering, delivery, and billing software to use the measured and calibrated flow rates (described under 10608.48.b(1)) for billing.	Updated tiered volumetric pricing structure with new structure and prices effective in 2025, after completion of the Proposition 218 process.	Continue implementing a tiered volumetric pricing structure, although the price will likely change over time. Continue using measured delivered volume and calibrated flow rates from EWMP 1 for billing.
Conditional EWMPs				
10608.48.c(1)	Facilitate alternative land use (lands with exceptionally high water duties, or lands that contribute to significant problems, e.g. drainage)	Not Technically Feasible (not an issue in TID – lands with exceptionally high water duties or significant problems do not exist in TID’s service area; Irrigation Rules prohibit wasteful use, precluding exceptional water duties or significant problems)	No change (Not Technically Feasible)	No change (Not Technically Feasible)
10608.48.c(2)	Facilitate recycled water use	- Dairy nutrient water and industrial process water from Hilmar Cheese is recycled and applied to TID irrigated lands. - Treated M&I water is recycled and applied to TID irrigated lands. - Spillage recovery and tilewater/tailwater flow into canals, where this water is available for reuse downstream. - Active spillage recovery from Harding Drain - Tertiary treated effluent from City of Turlock used for cooling at TID’s Walnut Energy Center	- Continued existing use of recycled water within TID service area, as listed in the previous column. 4,690 AF/year (2020-2024 average) combined reuse from M&I wastewater, dairy nutrient water, and Hilmar Cheese 1,860 AF/year (2020-2024 average) spillage recovery from Harding Drain 8,350 AF/yr (2020-2024 average) combined tilewater and tailwater into canals	- Continue existing use of recycled water within TID. - Plan to begin using recycled “offset” water from SRWA in the next five years - Continue working with cities and qualifying permitted dischargers to gain access to recycled water supplies.

Water Code Reference No.	EWMP	Implemented Activities (pre-2020 and ongoing)	Updates Since Last AWMP (2020-2025)	Planned Activities
		Completed Water Sales Agreement with SRWA in July 2015, with the provision that the SRWA will provide additional “offset” water to TID from recycled or stored groundwater supplies in exchange for surface water supplies from TID.	- Have continued using recycled water for cooling at Walnut Energy Center (1,000 AF/year) - Regional Surface Water Supply Project completed in 2023.	
10608.48.c(3)	Facilitate financing of capital improvements for on-farm irrigation systems	- TID has an active financing program for IDs, which support on-farm capital improvements (low interest financing, 10-yr loan term) - Offers engineering design and construction oversight for ID irrigation facilities. - Offers at-cost maintenance and repair of ID irrigation facilities (assessment process) - Pursues grant funding to assist growers with on-farm improvements (WaterSMART, etc.) - Hired assistant engineer with a background in agriculture whose primary duty is to provide on-farm technical support and design assistance to TID customers (e.g., micro/drip conversion and on-farm reservoir sizing)	- Continued offering existing programs and services, as listed in the previous column. - Continued searching for grant funding, including those to support on-farm improvements. - Adopted Turlock Subbasin GSP, which includes projects that facilitate on-farm improvements that encourage continued use of surface water (On-Farm Recharge Project (in WTSGSA))	- Continue offering existing programs and services. - Continue searching for grant funding, including those to support on-farm improvements. - Implement GSP projects that facilitate on-farm improvements that encourage continued use of surface water. - Work with growers to test subsurface recharge.
10608.48.c(4)	Implement an incentive pricing structure that promotes one or more of the following: (A) More efficient farm water use, (B) Conjunctive use, (C) Groundwater recharge, (D) Reduction in problem drainage, (E) Environmental resources management, (F) Effective management of all water sources throughout the year by adjusting seasonal pricing structures based on current conditions.	Tiered pricing structure promotes (A), (B), (C), and (F). Rates are higher with higher water use, promoting efficiency (A). Normal/dry year rates help to manage water by adjusting rates to reflect current water conditions (F) and by supporting TID’s conjunctive management strategy (B). Lower rates in normal years encourage recharge (C).	- Continued using tiered volumetric pricing structure, as listed in the previous column. - Updated tiered volumetric pricing structure with new structure and prices effective in 2025, after completion of the Proposition 218 process.	Continue implementing a tiered volumetric pricing structure, although the price will likely change over time.
10608.48.c(5)	Expand lining/piping of distribution systems, and construct regulatory reservoirs	Lining/Pipelines: - Lined or converted to pipelines in 92% percent of the distribution system downstream of La Grange Diversion Dam (222 miles out of ~240 miles). - In 2006-2008, lined ~4.5 miles of earthen canals. - In 2014, converted the Lower Stevinson Flume to a pipeline. - Lateral 1 and Upper Lateral 4 have been converted from open channels to pipelines in some developed areas. - Active gunite and lining maintenance program (~340,000 square feet of canal lining resurfaced each year (7.8 acres, or 0.012 square miles)) - Ponding tests conducted to quantify seepage rates in lined reaches. - Substantial portion of the 700 miles of ID conveyance facilities have been replaced by pipeline systems, with maintenance and replacement of aging or leaking pipes as needed. Regulating Reservoirs: - In 2015, TID completed the Lateral 8 Regulating Reservoir integrated with TCC on Lateral 8	- Continued gunite and lining maintenance program (~340,000 square feet of canal lining resurfaced each year (7.8 acres, or 0.012 square miles)) - Completed Ceres Main Canal Reservoir. - Completed design of the Lateral 5 ½ reservoir. - Obtained CEQA clearance to construct the Lateral 5 ½ regulating reservoir. - Completed two pilot projects with solar panels covering portions of canals to generate renewable energy and reduce evaporation	- Continue gunite and lining maintenance program. - Continue existing programs and efforts. - Potentially pursue select TID system modernization projects to be proposed in Draft IFMP, including regulating reservoir construction projects - Upon completion of GSP, there could be other GSP modernization projects that work in combination or in concert with other TID projects, including the Draft IFMP projects - Planning to construct Lateral 5 ½ regulating reservoir in 2026, depending on funding. - Evaluate two pilot projects with solar panels covering portions of canals to generate renewable energy and reduce evaporation

Water Code Reference No.	EWMP	Implemented Activities (pre-2020 and ongoing)	Updates Since Last AWMP (2020-2025)	Planned Activities
		- Expanded storage capacity of Lateral 8 Regulating Reservoir to 130 acre-feet in 2016 to allow more water to be regulated. - Completed Draft Irrigation Facilities Master Plan (IFMP), identifying, evaluating, ranking, and creating implementation strategies for potential distribution system modernization projects, including a variety of projects to potentially construct regulating reservoirs and improve canal conveyance. - Acquired land for a new regulating reservoir site, began design and preparation of an Initial Study in accordance with CEQA for the new regulating reservoir. - Conducted ponding tests at Turlock Lake as a means of evaluating existing reservoir operations, providing information about reservoir recharge to support efficient water management and to support decisions on future operations at Turlock Lake - Feasibility studies of reservoirs on the Ceres Main Canal		
10608.48.c(6)	Increase flexibility in water ordering by, and delivery to, water customers	- Expanded customers’ ability to request and receive non-standard delivery flows to serve drip and micro irrigation systems (standard flood head is 15 cfs) - Continued offering existing benefits to customers: - arranged-frequency demand deliveries - online ordering and online water use information - annual water use statement - access to real-time monitoring data - Continued operating and installing SCADA equipment to improve operational flexibility. - Completed Irrigation Delivery Operations Assessment in 2019 to evaluate the efficiency and flexibility of TID’s irrigation delivery system operation. - Compared parameters related to system flexibility, efficiency, and deliveries between TID and other California irrigation water suppliers. - Evaluated WDOs’ activities and roles in providing high-quality and flexible irrigation deliveries. - Completed Draft IFMP, creating a strategic plan and cost estimates for modernizing the TID system and infrastructure. These projects are conceptualized and designed with the goal of improving service levels, including delivery flexibility and consistency, to TID’s customers. - In 2015, allowed growers to pump groundwater into canals in exchange for a delivery “credit” of equal volume - TID offers arranged-frequency demand deliveries (arranged day; requested delivery flow rate; duration is controlled by customer) - Improvements to customer service - Central Call Center moved to Customer Service Department (2008) - Online ordering and online water use information (since 2014) - Water use information available upon request at any time; all growers are mailed annual water use statement (number/volume of irrigations, total water use), and those who register an email address receive monthly irrigation summary reports - Access to real-time monitoring from SlipMeters and FlumeMeters - Distribution system infrastructure improvements and monitoring allow WDOs greater flexibility in operating the system (giving them, in turn, greater flexibility to provide deliveries of various flow rates to growers) - SCADA equipment - real-time monitoring of flows, water levels, spillage, and intermediate system flows, and remote control of drainage	- Continued offering existing benefits to customers: - arranged-frequency demand deliveries - online ordering and online water use information - annual water use statement - monthly irrigation summary reports (registered email address) - access to real-time monitoring data - Continued operating and installing SCADA equipment to improve operational flexibility. - In 2024, the District began using an earliest delivery date option for customers. Wait times for these orders are 18-24 hours compared to 44-48 hours for all orders - Ceres Main Regulating Reservoir completed; increases delivery flexibility for growers.	- Continue offering existing benefits to customers: - arranged-frequency demand deliveries - online ordering and online water use information - annual water use statement - monthly irrigation summary reports (registered email address) - access to real-time monitoring data - in some dry years, allow growers to pump into canals for a delivery “credit” of equal volume. - Plan to continue offering non-standard delivery flows to customers, and providing flow rate calibrations in response to evolving customer needs - Continue operating and maintaining SCADA equipment and controls that allow WDOs to improve operational flexibility. - Potentially pursue select TID system modernization projects proposed under Draft IFMP.

Water Code Reference No.	EWMP	Implemented Activities (pre-2020 and ongoing)	Updates Since Last AWMP (2020-2025)	Planned Activities
		pump to better meet customer demands and prevent operational spillage. ○ Lateral 8 Regulating Reservoir and TCC Project (in operation since 2015) • In some dry years (e.g., 2014-2015), TID allows growers to pump groundwater into canals and receive a delivery “credit” of equal volume. This practice supplements the water supply available to downstream users, and allows growers the flexibility to transport water that they pump to any of their fields served by an active sidegate.		
10608.48.c(7)	Construct and operate supplier spill and tailwater recovery systems	• WDOs have continued remote monitoring of spillage sites using SCADA, and remote operation of drainage wells to reduce spillage. • Continued interception and recovery of spillage and excess water in the TID system, utilizing this water to the greatest extent possible for deliveries downstream. • Expanded capacity of Lateral 8 Regulating Reservoir to 130 acre-feet in 2016, increasing the storage of excess flows and water that would have otherwise spilled from Lateral 8 and the Highline Canal • Ongoing implementation of the SCADA Master Plan TID; canals passively intercept spillage from the upper laterals allowing water to be utilized to the greatest extent possible for deliveries downstream. • TID system intercepts undelivered irrigation water from ID pipelines • TID system recovers and reuses tilewater and tailwater that re-enter system. • Spillage is actively recovered from Harding Drain. • Lateral 8 Regulating Reservoir and TCC project regulates excess flows and reduces spillage from Lateral 8 • WDOs use tablets and computers in the field to access real-time SCADA data at spillage sites and other locations in the system, allowing better control over the system to reduce spillage. • Operation of drainage wells (many of which are remotely operable) and rented wells to provide a localized source of supply to match demand and reduce spillage. • Created and implemented SCADA Master Plan, which has helped to reduce spillage through increased mobile data access, remote operation and monitoring of irrigation control structures, and improved system redundancy	• Continued interception and recovery of spillage and excess water in the TID system, utilizing this water to the greatest extent possible for deliveries downstream. • WDOs have continued remote monitoring of spillage sites using SCADA, and remote operation of drainage wells to reduce spillage. • Ceres Main Canal Reservoir was completed.	• Plan to continue operation of distribution system and SCADA to recover and reduce spillage. • Planning to implement canal modernization projects to reduce spillage and increase delivery flexibility • Planning to construct Lateral 5 ½ regulating reservoir in 2026
10608.48.c(8)	Increase planned conjunctive use of surface water and groundwater within the supplier service area	• Continued conjunctive management program. • Enhanced conjunctive management by modifying operations to pump even less in normal and wetter years to further increase the use of available surface water and allow for in-lieu groundwater recharge, with lower rented pumping on average in the last five years as compared to the historical past. • Continued remote operation of drainage wells to carefully control pumping and increase groundwater recharge. • Active participation in local groundwater entities and initiatives, including SGMA efforts. • Active engagement in the development of a groundwater recharge assessment tool (GRAT) for the Turlock Subbasin • Conducted ponding tests at Turlock Lake as a means of evaluating existing reservoir operations, providing information about reservoir recharge to support efficient water management and to support decisions on future operations at Turlock Lake. • TID implements a comprehensive conjunctive management program in its regular operations.	• Continued conjunctive management program. • Enhanced conjunctive management by modifying operations to pump even less in normal and wetter years to further increase the use of available surface water and allow for in-lieu groundwater recharge, with lower rented pumping on average in the last five years as compared to the historical past. • Continued remote operation of drainage wells to carefully control pumping and increase groundwater recharge. • Improved monitoring and tracking of off-season flows through the system, supporting better management of this water and the District’s ability to make use of this water locally. • Adopted Turlock Subbasin GSP. • Active participation in local groundwater entities and initiatives, including SGMA efforts. • Active engagement in the development of the groundwater recharge assessment tool for the Turlock Subbasin • Continued active runoff forecasting and surface water supply management through the ARSS, F-CO, FIRO, and watershed monitoring programs.	• Plan to enhance conjunctive management program and related practices. • As a member of the West Turlock Subbasin GSA, adopt and begin implementing the Turlock Subbasin Groundwater Sustainability Plan (GSP), with plans to achieve groundwater sustainability by 2042. • Continue the recharge programs and implementation of the Turlock Subbasin GSP. • Continue expanding groundwater monitoring under SGMA. • Continue engagement in the development and application of a groundwater recharge assessment tool (GRAT) for the Turlock Subbasin. • Continue active runoff forecasting and surface water supply management through the ARSS, F-CO, FIRO, and watershed monitoring programs. • Improve monitoring and tracking of off-season flows through the system, supporting better management of

Water Code Reference No.	EWMP	Implemented Activities (pre-2020 and ongoing)	Updates Since Last AWMP (2020-2025)	Planned Activities
		- TID has a series of pre- and post-1914 water rights that provide secure surface water supplies. - In dry years, TID operates drainage wells and rents privately-owned wells to increase water supply. - Tiered pricing structure in normal and dry years - Affordable pricing to promote the use of available surface water supplies in all years. - Lower volumetric prices in normal years to incentivize surface water use and recharge. - Higher volumetric prices and fixed charges in dry years to promote water conservation and to provide revenue to operate drainage and rented wells required to pump additional groundwater. - In certain wet years when sufficient water is available, TID promotes direct and in-lieu recharge through “replenishment water” sales within the Subbasin but outside of the TID service area. - Use of treated wastewater for cooling at the Walnut Energy Center, as a substitute for groundwater - Implementation of groundwater monitoring as part of CASGEM. - Development of sophisticated groundwater and surface water models to support long term conjunctive use planning and management. - TID actively forecasts runoff and manages surface water supply through ARSS, F-CO, FIRO, and watershed monitoring programs.	- Initiated active recharge programs - Diane Storm Basin - TID On-Farm Recharge Project - Agricultural Recharge Project - Updated water budget to include the Upper Main Canal and Turlock Lake, supporting better accounting for all inflows/outflows, including recharge.	this water and the District’s ability to make use of this water locally.
10608.48.c(9)	Automate canal control structures	- Continued operation of existing automatic canal control structures and SCADA sites - Installing 72 Rubicon gates. - Completed Draft IFMP, creating a strategic plan and cost estimates for modernizing the TID system and infrastructure, including canal system automation projects. - Ongoing implementation of TID’s Irrigation Capital Plan, which provides for automation and rehabilitation of canal control structures (drop structures, etc.) as part of normal TID operations. - TID operates more than 345 automatic canal control structures, including 61 Meikle automatic gates, 227 long-crested weirs, flap gates (18 locations), Rubicon FlumeGates™ (72 locations), and other structures. - TID has been installing Rubicon FlumeGates and SlipMeters at many canal head gate structures, with SCADA integration and remote operability. - Created and implemented SCADA Master Plan, and now operates 397 SCADA sites, providing control and/or real-time flow and water level information throughout the canals, including at lateral headgates. - All structure modifications are designed to allow for future modification. - Lateral 8 Regulating Reservoir and Total Channel Control (TCC) implemented on Lateral 8 beginning in 2015, allowing near-full automated control of flows along Lateral 8.	- Continued operation of existing automatic canal control structures and SCADA sites - Installed 129 new Rubicon gates, now at 72 locations in the distribution. - Ongoing implementation of TID’s Irrigation Capital Plan, which provides for automation and rehabilitation of canal control structures (drop structures, etc.) as part of normal TID operations. - Implemented SCADA Master Plan, and now operates 493 SCADA sites, providing control and/or real-time flow and water level information throughout the canals, including at lateral headgates (all lateral headings now have a Rubicon gate controlling flow).	- Continue operating existing automatic canal control structures and SCADA sites. - Continue installing Rubicon gates. - Consider pursuing select canal automation modernization projects. - Ongoing implementation of TID’s Irrigation Capital Plan, which provides for automation and rehabilitation of canal control structures (drop structures, etc.) as part of normal TID operations. - Continue to review delivery measurement accuracy and customer needs and consider if additional permanent flow measurement devices should be installed. - Ceres Main TCC Pilot Project to test Rubicon full canal and delivery automation
10608.48.c(10)	Facilitate or promote customer pump testing and evaluation	- TID conducts a pump testing program and provides testing services for private pumps upon request throughout the District’s irrigation and electrical service areas. - TID historically tested rented pumps once per year. - TID uses portable flow meters to test customer wells. Two staff members are available for water level testing and twelve WDOs plus additional staff are available for flow testing. - TID trained employees in pump testing methods	Continued pump testing program for District-owned and rented pumps, and offering pump testing services for private pumps upon request (fewer tests over last 3-5 years as manpower has been redirected to delivery measurement accuracy field-testing efforts)	Continue pump testing program and offering pump testing services

Water Code Reference No.	EWMP	Implemented Activities (pre-2020 and ongoing)	Updates Since Last AWMP (2020-2025)	Planned Activities
10608.48.c(11)	Designate a water conservation coordinator	- Water Conservation Coordinator position was established in 1997. - Position is currently filled by the District’s Water Planning Department Manager	Appointed a Water Conservation Coordinator in 2025 (Courtney Malmberg)	Continue employment of a Water Conservation Coordinator.
10608.48.c(12)	Provide for the availability of water management services to water users.	On-farm irrigation and drainage system evaluations: - TID provides services to build, operate, and maintain improvement district (ID) facilities, including on-farm distribution and irrigation facilities, subsurface drains, and deep wells. - TID staff provide testing upon request for pump flow rates and application rates through pressurized irrigation systems using Fuji flow meters. Normal Year and Real-time Irrigation Scheduling and Crop Evapotranspiration Information - TID installed CIMIS stations #168 (now inactive) and #168 at Denair in 2002 and 2009. - TID provides growers with CIMIS website information, tutorials, and data through links on the TID irrigation information web page. - TID provides growers with weather forecasts and precipitation forecasts on the TID weather web page. Surface water, groundwater, drainage water quantity and quality data: - Parcel water use information available at any time online, or upon a grower’s request - Water use information provided to all growers in year-end water use report. - Real time flows, water level, and storage are available on the TID website for various sites operated or used by TID: - Real-time flows, water level, and storage available for six sites via TID’s WISKI web portal - Current report and link to current flows at the Tuolumne River below La Grange Dam available on TID website - Links to seven online telemetry gauges used by TID and reported by USGS NWIS are available through the TID website. - CASGEM groundwater monitoring implemented by TID. - Information about groundwater supply wells provided by TID staff through pump tests. - Upper Tuolumne River watershed collaborative project to implement Forecast Informed Reservoir Operations (FIRO), a reservoir-operations forecasting strategy that is communicated to the TID Board of Directors, and available to the public through the Board process. - Suitability of surface water, groundwater, and drain water quality for irrigation is tested by TID staff and available to growers upon request. - Surface water monitored at Main Canal Drop 1 (Turlock Lake supply) and all spill locations twice during each irrigation season. - Groundwater samples from drainage wells and rented wells monitored as needed, upon request, and during the formation of a pump Improvement District. - Subsurface drainage at 32 tile drain discharge sites historically evaluated on a quarterly basis - Canal flows monitored by multi-parameter water quality sensors at 18 canal and drain locations, recording EC and temperature and upload the data to TID’s SCADA system. Agricultural water management educational programs and materials: - TID regularly prepares and distributes “The Grower” irrigation newsletter to growers, staff, and the public (now quarterly)	- Continued offering on-farm irrigation and drainage system services upon request: - Engineering services for ID facilities, including on-farm distribution and irrigation facilities, subsurface drains, and deep wells. - Pump flow rate testing and irrigation system application rate testing - Continued offering irrigation scheduling and crop evapotranspiration information (links to CIMIS information, weather, and precipitation forecasts on TID website) - Contracted with Land IQ to receive monthly crop ET data. - Continued monitoring and offering surface water, groundwater, and drainage water quantity and quality data to growers: - Water use information online, upon request, and in annual water use report - Real-time flows, water level, and storage data available online - Pump tests conducted for groundwater supply wells. - Continued CASGEM groundwater monitoring and plans for SGMA groundwater monitoring. - Continued and formalized FIRO forecasting - Continued monitoring suitability of surface water, groundwater, and drain water quality for irrigation (monitoring less frequent in recent years because of other operational efforts underway in TID) - SGMA annual reports track groundwater storage. - Continued providing agricultural water management educational programs and materials to growers, staff, and the public: - Prepared and distributed “The Grower” irrigation newsletter - Maintained and updated the “Irrigation Information” and “Education” webpages with resources and educational materials. - Maintained and updated the “Irrigation” webpage with links to educational materials and water data. - Continued targeted social media messaging. - Continued supporting local educators by participating in school assemblies, demonstrations, and career days. - Continued providing remote data access to staff and growers from SlipMeters and FlumeMeters. - Began shifting away from annual grower meetings and moving toward direct mailings and expanded use of new virtual communications mediums (social media, etc.) to enhance grower engagement. - Initiated periodic podcasts describing TID operations.	- Continue offering existing on-farm irrigation and drainage system services upon request. - Continue offering existing irrigation scheduling and crop evapotranspiration information. - Continue monitoring and offering surface water, groundwater, and drainage water quantity and quality data to growers. - Continuing SGMA-related public outreach and involvement. - Begin implementing the Turlock Subbasin Groundwater Sustainability Plan (GSP) - Continue and expand groundwater and surface water monitoring under SGMA. - Continue providing agricultural water management educational programs and materials to growers, staff, and the public. - Continue targeted social media messaging. - Provide on-farm technical support for checking: <i>On-farm irrigation system designs</i> <i>On-farm reservoir designs</i> <i>Grower training sessions</i> - Continue producing periodic podcasts.

Water Code Reference No.	EWMP	Implemented Activities (pre-2020 and ongoing)	Updates Since Last AWMP (2020-2025)	Planned Activities
		- TID’s “Irrigation Information” webpage provides a wealth of resources and educational materials in an accessible and user-friendly format. - Irrigation tips for water conservation - Information on Rubicon gates - CIMIS weather station data - Water measurement educational resources - Groundwater management educational resources - TID’s most recently adopted AWMP and supporting documents. - TID’s “Irrigation” webpage provides links to educational materials and data from Don Pedro Reservoir, La Grange Dam, Turlock Lake, and other locations in the TID distribution system. - TID supports local educators by participating in school assemblies and demonstrations as well as career days and has created an “Education” webpage that provides education guides and videos to the public. - TID has developed training videos for staff, irrigators, and growers that provide information on the operation of Rubicon sidegates. These videos are available in English and Spanish on the TID website. - TID provides remote data access to staff and growers, providing delivery flows data for sidegates with SlipMeters and permanent FlumeGates. - TID employs an assistant engineer with a background in agriculture who provides on-farm technical support. Services include support of micro/drip conversion and on-farm reservoir sizing. - TID conducted annual grower meetings. - TID conducts occasional seminars for growers on various water management topics		
10608.48.c(13)	Evaluate the policies of agencies that provide the supplier with water to identify potential changes that allow more flexible deliveries and storage.	- TID partners with cooperating entities at Don Pedro Reservoir. - TID implements ARSS, F-CO, FIRO, and watershed monitoring to better track and understand the amount of water in the upper watershed and inform reservoir operations. - TID coordinates with applicable regulatory agencies that have the potential to impact the District’s flexibility in delivery and storage. - TID is a member of the West Turlock Subbasin GSA and is active in SGMA implementation and GSP development.	- Continued partnership with cooperating agencies and applicable regulatory agencies that have the potential to impact the District’s flexibility in delivery and storage. - Implementation of ARSS, F-CO, FIRO, and watershed monitoring to better track and understand the amount of water in the upper watershed and optimize reservoir operations to balance flood storage and water supply storage. - Active participation in local groundwater entities and initiatives, including SGMA efforts.	- Continue partnership with cooperating agencies and applicable regulatory agencies. - Continue implementation of ARSS, F-CO, FIRO, and watershed monitoring. - Continue active involvement in SGMA implementation, GSP development, and GSP implementation in coordination with other agencies in the Turlock Subbasin.
10608.48.c(14)	Evaluate and improve the efficiencies of the supplier’s pumps.	- TID has historically tested District-owned and rented wells generally once per year when in use, or upon request. - TID has trained employees in pump efficiency testing. - TID has a pump capital improvement program to rehabilitate and replace pumps when necessary. - TID has provided remote operation capabilities for many drainage wells. WDOs can turn on and shut down pumps using portable tablets to reduce operational spillage, reduce pump wear and tear, prolong pump life, and improve pump efficiency.	- Continued pump testing program for District-owned and rented pumps, and offering pump testing services for private pumps upon request (limited testing over last 3-5 years as manpower has been redirected to delivery measurement accuracy field-testing efforts) - WDOs have continued remote operation of drainage wells to reduce pump wear and tear, prolong pump life, and improve pump efficiency	- Continue pump testing program and offering pump testing services. - Continue providing remote pump operation capabilities to WDOs.

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1. Plan Preparation

A critical component in the development of an Agricultural Water Management Plan (AWMP or Plan) is the solicitation of feedback from interested parties. This section describes TID's coordination with other agencies in the development of this AWMP, as well as TID's past water management activities.

1.1 PAST WATER MANAGEMENT ACTIVITIES

The Turlock Irrigation District (TID or District) was the first irrigation district formed in California under the Wright Act in June 1887. Although the current Agricultural Water Management Planning requirements were recently established, water management planning is not a new concept for TID. The District continues to evaluate and implement new cost-effective approaches and technologies to support water management as they become available. These efforts ensure the District's water resources are managed to meet local water supply needs and environmental stewardship requirements, both now and in the future.

TID was one of the first agencies in California to adopt a Groundwater Management Plan pursuant to Assembly Bill 3030, to sign on to the Memorandum of Understanding (MOU) establishing the Agricultural Water Management Council (AWMC), and to prepare an AWMP approved by the AWMC. TID's first AWMP was adopted in July 1999 and approved by the AWMC in May 2001. TID was also one of the first agencies in California to comply with SBx7-7 and submit their plan to the California Department of Water Resources (DWR) in 2012. Since that time, TID has implemented all locally cost-effective and technically feasible Efficient Water Management Practices (EWMPs). Some key implementation efforts that benefit water management in TID include:

- Automation of canal control structures.
- Improved measurement of canal and delivery flows through TID's extensive SCADA network and access to real-time data by field crews.
- Implementation of a comprehensive plan to accurately measure water deliveries to customers, in compliance with delivery measurement requirements (pursuant to 23 CCR §597). This plan has resulted in:
 - Installation of 153 new, permanent Rubicon measurement devices at sidegates, sites downstream of sidegates, and ID pipeline spillage sites throughout the District.
 - Calibration of delivery flow rates at all other active, existing sidegates in the District.
- Installation of water quality monitoring telemetry.
- Lining or pipeline conversion of the District conveyance and distribution system, ongoing maintenance, and other facility modifications to improve delivery reliability and operational flexibility.
- Improved water balance accounting through the District's semi-automated water balance application.
- Installation of a California Irrigation Management Information System (CIMIS) weather station to provide more accurate local crop ET information to growers.

- Adoption of a volumetric pricing structure.
- Employment of an assistant engineer with a background in agriculture to provide on-farm technical support.
- Improved access to water use and real-time water supply information, which are available to customers online or upon a grower's request.
- Implementation of remote operation of District-owned pumps.
- Implemented improvements along Lateral 8 to test the pairing of regulating reservoirs and automation to provide Total Channel Control (TCC) features on TIDs open channel system.
- Ongoing development of a multi-year planning effort to improve irrigation service and modernize infrastructure, referred to as the TID draft Irrigation Facilities Master Plan (IFMP).
- Completion of the TID Irrigation Delivery Operations Assessment study to evaluate the efficiency and flexibility of TID's irrigation delivery system operations and recommend strategic actions for maintaining and improving operations in the future.
- Active participation in local groundwater initiatives and efforts for compliance with the Sustainable Groundwater Management Act of 2014 (SGMA), including membership in the West Turlock Subbasin Groundwater Sustainability Agency (WTSGSA) and development of the Turlock Subbasin Groundwater Sustainability Plan (GSP).
- Continued implementation of numerous other measures to provide information to growers and to ensure water delivery reliability and flexibility.

All actions, programs, and efforts that TID has completed or plans to complete in the future to support efficient water management are described in **Section 7** of this AWMP, and elsewhere throughout the plan.

1.2 AGENCY COORDINATION AND PUBLIC PARTICIPATION

Coordination with other agencies and public participation are critical components of the agricultural water management planning process. The following section describes the on-going coordination efforts between TID and the various local agencies in this region that manage water resources. Additionally, this section provides information on the public participation process used during the development, adoption, and implementation phases of the planning process.

1.2.1 Agency Coordination

TID holds joint water rights and ownership of Don Pedro Reservoir with the Modesto Irrigation District (MID). As such, the districts (TID and MID) continuously work together to coordinate and manage the shared resource. Additionally, TID maintains close relationships with irrigation districts on other tributaries of the San Joaquin River, and through those relationships is able to share information regarding successes and challenges to help shape irrigation programs. TID works and coordinates with the City and County of San Francisco, San Joaquin Tributaries Authority (SJTA), the East San Joaquin Water Quality Coalition (ESJWQC), as well as various water committees and groups forming at the county and state levels. Each authority and association is involved in activities that relate to different aspects of the District's water management activities. Additionally, TID coordinates with various local, state, and federal agencies as outlined in the Drought Management Plan (**Appendix G**).

TID adopted its first Groundwater Management Plan (GWMP) in 1993. After that time, other agencies within the Turlock Subbasin became interested in groundwater management. As a result, the Turlock Groundwater Basin Association (TGBA) was formed in 1995 to develop a Subbasin-wide GWMP. The first plan was adopted in 1997 by the majority of the water agencies within the Subbasin. The TGBA continued to coordinate groundwater management activities, completed several studies, and updated the Subbasin-wide GWMP. TID adopted the most recent updated plan on March 18, 2008.

Agencies within the Turlock Subbasin have formed two Groundwater Sustainability Agencies (GSAs) to comply with the Sustainable Groundwater Management Act of 2014 (SGMA). The West Turlock Subbasin GSA (WTSGSA) includes the area within the TID’s irrigation boundaries. The East Turlock Subbasin GSA (ETSGSA) generally covers the area to the east of the WTSGSA. TID is an active member of the WTSGSA, with staff helping to facilitate GSA activities. The GSAs have a Memorandum of Agreement that outlines the process by which the GSAs are working together to ensure the Subbasin is in compliance with SGMA. Both GSAs were actively engaged in developing a single Groundwater Sustainability Plan (GSP) for the Subbasin. In January 2024, the Department of Water Resources (DWR) determined that the GSP was “incomplete” and in July 2024 the Turlock Subbasin submitted a Revised GSP to DWR for review and approval. In February 2025, DWR approved the Revised GSP with recommended corrective actions that the GSAs address. With the approval of the GSP, the Turlock Subbasin is focusing on implementing the projects and management actions described in the GSP and completing the GSP Periodic Evaluation, which is due January 2027.

1.2.2 Plan Participation

TID has prepared this AWMP in accordance with the requirements of the Water Conservation Act of 2009, also known as SBx7-7, enacted November 9, 2009, and the 2018 Water Conservation Legislation (AB 1668 and SB 606). The Department of Water Resources also provided a draft guidebook for the 2020 plans due in April 2021. The legislation itself and the guidebook provide limited guidance regarding the outreach process to be followed while developing and adopting an AWMP, providing flexibility for agencies to implement an outreach process focused on the needs of the local area.

Table 1.1, below, describes the public participation process that was employed for this AWMP. TID patterned the agency coordination and public participation process in reference to the DWR guidebook for agencies, and after similar planning efforts implemented by local urban water suppliers, as well as past efforts for developing and implementing the Subbasin-wide GSP, and the 2020 AWMP. The process made use of existing communication programs, association memberships and coordination to help to streamline the effort.

Table 1.1. AWMP Public Participation Process.

Activity	Date(s)
Letter notice to local water agencies – Plan to update AWMP	January 15, 2026
TID Board – Set Public Hearing for March 17, 2026 and directed staff to publish notice in newspaper, and make draft Plan available for public comment on-line (Requires 30 day public comment period)	February 17, 2026
Copies of draft AWMP available for review on-line	February 18, 2026
Letters to local water agencies – Draft AWMP available for comment	February 18, 2026
Newspaper Notice Published in The Modesto Bee and The Turlock Daily Journal – per Government Code Section 6066	February 18, 2026; February 25, 2026;
Public outreach ahead of the public hearing and AWMP adoption meeting through social media messaging	February 27, 2026;
Public Hearing & AWMP adoption on same day	March 17, 2026
Copies of approved AWMP available on TID’s website and distributed as required by SBx7-7	April 2026

Copies of the information circulated in the public outreach effort are included in **Appendix A**.

Ongoing coordination and implementation of the AWMP will be facilitated by continuing interactions with other local water agencies and TID customers. Examples of these programs include:

- Coordination with the MID through their partnership in management of Don Pedro Reservoir.
- Coordination with other local public agencies, including the counties and agricultural and urban water supply agencies, through Technical Advisory Committee (TAC) meetings of the GSAs; an association that was formed to coordinate groundwater management activities within the Turlock Subbasin. Information about the Turlock Subbasin GSP and a link to where the complete plan can be accessed and downloaded online are included in **Appendix B**.
- Coordination of SGMA activities with the local GSAs and the water agencies and counties engaged in those efforts.
- Stanislaus County has established a Water Advisory Committee and a Technical Advisory Committee to coordinate water issues within the County. TID has representatives on both committees. TIDs involvement in these efforts will assist with outreach and coordination efforts.
- Growers in TID are kept informed of various TID activities and irrigation-related issues. Historically, this outreach was done through grower meetings typically held at the start of each irrigation season. However, staff are moving to incorporate more direct mailings and new virtual communications mediums (social media, etc.) to enhance grower engagement.
- TID staff have increased the publication frequency of “The Grower” newsletter to quarterly, and have completed a redesign of the newsletter to encourage greater engagement. Copies of past newsletters are available on TID’s website at <https://www.tid.org/news-resources/resource-library/>. An example newsletter is included in **Appendix C**.

- TID’s Board of Directors generally meets weekly. Board meetings provide an opportunity to educate and obtain feedback from the Board and the public regarding a wide range of water management related topics. The media and the public regularly attend these meetings. During each meeting, time is set aside to update the Board on District activities, and receive comments from the public. Due to the ongoing pandemic in 2020 and 2021, Board meetings have been held remotely, with the ability for the public to participate online. Meetings have been held generally twice per month at this time. Board meeting dates, times, agendas, and access information are available on the District’s website. Board meetings are also recorded and posted on the District website.
- The District’s communications staff regularly communicates with the media regarding a variety of topics, issuing press releases as needed regarding District activities. The media also regularly reports on the issues, policies and projects discussed at TID Board meetings.
- TID staff have conducted multiple focus groups with a diverse group of growers to discuss the latest regulatory actions that may impact TID operations.
- TID staff conducted a grower communication survey in 2025 to better understand how growers prefer to be communicated with, and what information they want to receive from the District.
- The District’s communications staff has increased its social media presence across multiple platforms, providing content specifically developed to keep the growers informed and up to date with the latest information.
- The TID website is updated regularly. It includes a variety of information regarding TID’s water management programs and practices. Information regarding the AWMP update is available at: www.tid.org/AWMP. The adopted AWMP is also available on TID’s website.

1.3 PLAN ADOPTION AND SUBMITTAL

1.3.1 Plan Adoption

A copy of the signed Resolution of the 2025 Agricultural Water Management Plan Adoption is included in **Appendix A**, as an attachment to this AWMP.

This AWMP is anticipated to be adopted on March 17, 2026, before the April 1, 2026 update deadline.

1.3.2 Plan Submittal

This AWMP has been submitted electronically to DWR through the AWMPs portal on the DWR WUE data website (<https://wuedata.water.ca.gov/>). Submittal occurred no later than 30 days after the plan adoption.

1.3.3 Plan Availability

This AWMP has been made available to the public, local water agencies, and other entities through the public participation process described in **Table 1.1** and in **Section 1.2.2**, above. Information regarding the AWMP update is available at: www.tid.org/AWMP. The updated and adopted AWMP has been posted on the TID website within 30 days of adoption.

1.4 PLAN IMPLEMENTATION

TID has taken many actions to promote efficient and sustainable water management throughout its more than 130-year history. Today, TID continues to review and plan additional measures to accomplish improved and more efficient water management. For the purposes of this AWMP, TID's past, ongoing, and planned actions have been organized and are reported with respect to the Efficient Water Management Practices (EWMPs) listed in Water Code §10608.48.

A summary of the past and planned implementation efforts for this AWMP are described in **Section 7** of this AWMP, outlined according to the EWMPs that these efforts support (**Tables ES.1 and 7.4**). Other efforts specifically related to drought are described in the District's Drought Management Plan (**Appendix G**). Drought resilience efforts are implemented in all years, while drought response efforts are implemented in years of reduced water availability, as determined by the District's Board of Directors.

TID and its staff has long been active in agricultural water management planning, and affiliated with organizations that support excellence in water management, including the Association of California Water Agencies (ACWA), the California Farm Water Coalition (CFWC), the United States Committee for Irrigation and Drainage (USCID), the Irrigation Technology and Research Center (ITRC), the American Society of Civil Engineers (ASCE), the California Irrigation Institute (CII), the California Municipal Utilities Association (CMUA) and others. One of the benefits that TID's active participation in these organizations brings is continuing exposure to water management innovations through conferences, trainings, and networking with water management professionals. Additionally, TID occasionally sends staff to water management trainings to enhance skill sets and increase basic understanding of efficient water management.

TID will continue its engagement in agricultural water management planning and in the water management community, supporting water management advancements in the District, throughout California, and beyond.

2. Agricultural Water Supplier and Service Area

This section contains a description of the physical and operational organization of the Turlock Irrigation District, including TID’s history, geographic and environmental settings, operations, and policies.

2.1 PHYSICAL CHARACTERISTICS

2.1.1 History and Size

TID provides irrigation water to agricultural lands in Stanislaus and Merced counties in the Central Valley of California. TID was formed on June 6, 1887, and was the first irrigation district formed in California under the Wright Act. At the time of its formation, TID covered 179,527 acres. TID presently covers a service area of 197,261 gross acres, with approximately 157,800 acres that could be served by active TID irrigation service connections. The average assessed acreage from 2020 through 2024 was 139,925 acres, and the average irrigated acreage from 2020 through 2024 was 131,527 acres. The actual number of acres that irrigate each year varies depending on the decisions of the individual property owners. These and other key aspects of TID are summarized in **Table 2.1**. The increase in gross acreage from the time of District formation is attributed to the annexation of adjacent lands including Turlock Lake, the community of Delhi, and a portion of Don Pedro Reservoir.

Table 2.1. Water Supplier History and Size.

Date of formation	June 6, 1887
Local surface water source	Tuolumne River
Local groundwater source	Turlock Subbasin
Gross acreage at time of formation	179,527 acres
Present gross acreage	197,261 acres
Present irrigable acreage¹	157,800 acres

¹ Acreage that could be served by active irrigation service connections.

2.1.2 Location and Facilities

TID’s irrigation service area is generally bounded on the north by the Tuolumne River, on the south by the Merced River and on the west by the San Joaquin River (see maps included in **Appendix D**). The communities of Turlock, Ceres, Keyes, Denair, Hughson, Delhi, South Modesto, Hickman, and Hilmar are within the boundaries of the TID irrigation service area. This section of the AWMP describes TID irrigation facilities and operations within its service area. A summary of TID’s irrigation facilities and operations is provided in **Table 2.2**.

The Tuolumne River provides the principal water supply for TID. Don Pedro Reservoir is located on the Tuolumne River and is TID’s principal storage reservoir, with a total capacity of 2,030,000 acre-feet (AF). Don Pedro Reservoir is jointly owned by TID and MID (68.46% by TID, and 31.54% by MID). TID operates the reservoir for the districts.

It is important to note that a portion of Don Pedro Reservoir’s storage capacity is reserved for flood control purposes each year and operated in compliance with the Army Corps of Engineers (ACOE) requirements. To vacate the 340,000 AF flood control space, reservoir levels are

SECTION TWO

AGRICULTURAL WATER SUPPLIER AND SERVICE AREA

lowered each fall to a specified elevation (801.9 feet above mean sea level) by October 7th. Levels are allowed to gradually increase again after April 27th.

Table 2.2. TID Water Conveyance and Delivery System.

Facility/System	Description
<i>Storage facilities</i>	
Don Pedro Reservoir capacity ¹	1,178,197 AF
Turlock Lake capacity ²	45,600 AF
<i>Conveyance facilities and other Infrastructure</i>	
Unlined Canals	18.5 miles ³
Lined Canals	222 miles ³
Automation, Rubicon Total Channel Control (TCC)	9 miles
Regulating Reservoirs	Ceres Main (220 AF) Lateral 8 (130 AF)
Number of Canal Turnouts	1,411 operational sidegates (2020-2024)
TID-owned Drains	18 miles
Recharge Facilities	On-Farm Recharge Project (306 AF in 2024) Dianne Storm Basin ⁴ (640 AF in 2024)
Drainage Wells	111 Active / 153 Total (2020-2024)
Rented Wells	67 to 137 (2020-2024), depending on water year type and weather conditions
<i>Tailwater/Spill Recovery Facilities</i>	
TID-operated	Operational spills ⁵
Grower-operated Tailwater/Spill Recovery	Individual grower tailwater systems ⁶
<i>Supplier Delivery System</i>	
Order type/scheduling	Arranged-frequency demand (ASCE, 1991)
Operational constraints	Canal capacity flow limitations
Expected changes to service area	None

¹ TID's useable capacity in Don Pedro is 68.46 percent of overall 2,030,000 AF reservoir capacity minus 68.46 percent of the minimum operating pool.

² Maximum lake capacity is 45,599 AF between April 1 and November 1 (summer operation) at an elevation of 240.6 feet, and 35,000 AF between November 1 and April 1 (winter operation) at an elevation 237.2 feet.

³ Miles of lined and unlined canals downstream of La Grange Diversion Dam.

⁴ Under a Memorandum of Understanding with the City of Turlock.

⁵ TID accepts a minor amount of tailwater into its canals that is blended with surface water supplies for deliveries; spills from upper canals are intercepted by the Ceres Main Canal and utilized to the greatest extent possible for delivery to downstream canals. Spillage into ditches that flow back into TID canals can also be reused for distribution downstream. TID also recaptures spills from the Harding Drain.

⁶ Grower operated tailwater systems are installed to make use of water and to comply with relevant water quality requirements.

Flood control operations, combined with variable hydrology and operation of reservoirs upstream on the Tuolumne River, influence Don Pedro Reservoir storage levels and the available surface water supplies each year.

La Grange Diversion Dam was constructed in 1893 and is located on the Tuolumne River, downstream of Don Pedro Reservoir near the community of La Grange. Water released from Don Pedro Reservoir is diverted from the river into the TID Upper Main Canal at the La Grange Diversion Dam.

As shown in the maps included in **Appendix D**, TID’s distribution system begins at La Grange Diversion Dam where water, released from Don Pedro Reservoir for irrigation purposes, is diverted into the TID Upper Main Canal for conveyance to Turlock Lake. Turlock Lake is an important component of the TID’s irrigation system with a maximum capacity of 45,600 AF (**Table 2.2**). TID operates Turlock Lake to store and release irrigation water supplies, to balance irrigation deliveries with irrigation demand, and to minimize flow fluctuations in the District’s irrigation canals and laterals. From Lake Turlock, water is released into the Main Canal for distribution to downstream growers for irrigation purposes.

In total, TID’s conveyance and distribution system downstream of La Grange Diversion Dam consists of approximately 241 miles of canals, of which 222 miles are fully or partially lined (92%). The unlined canals are located primarily in upland areas underlain with hard clay soils with very low infiltration rates. TID has an active gunite and lining maintenance program and resurfaces an average of 2.5 miles or 330,000 square feet (7.6 acres, 0.012 square miles) of canal lining each year, based on data from the 2000-2024 period. The last new canal lining occurred during the winters of 2006-2007 and 2007-2008, when TID lined approximately 4.5 miles of existing earthen canals for operational purposes.

Three main delivery canals run north to south, and laterals run east to west from the canals. Upper laterals terminate into the lower delivery canals, allowing any excess water in the upper laterals to be utilized for deliveries from the lower canals. Several interconnections between canals provide additional operational flexibility, enabling the District to capture water that may otherwise spill. Additionally, in the last ten years, TID has constructed two regulating reservoirs (Ceres Main and Lateral 8) to provide improved customer service and reduce spillage.

A small volume of tailwater flows to agricultural drains and is intercepted by the TID distribution system and blended with surface water supplies for delivery to TID growers. Additional information on tailwater in the TID irrigation service area is described in **Sections 2.1.3, “Terrain and Soils”** and **2.2.1.4, “Drainage and Tailwater Policies.”**

TID owns and maintains the distribution system from Turlock Lake down to each sidegate: the point at which water is delivered from the District to the individual fields. Growers are responsible for building, operating and maintaining the distribution facilities from the sidegate to the field. A variety of private and improvement district facilities have been designed and built over time to meet this need. (See **Section 2.1.2.1** for more information regarding Improvement Districts.)

TID’s canal distribution system is a gravity flow system. Water in the canals not utilized for irrigation purposes flows through the canals and is released into drains or downstream rivers. These locations are called spills. There are a total of 15 spill locations from the distribution system. Six of the spills flow directly to rivers and the remaining nine are consolidated into three drains that flow to the river system.

TID practices conjunctive management of surface water and groundwater by maximizing the use of surface water for irrigation and recharge during wet years. This strategy helps reduce groundwater reliance and supports subbasin sustainability. As part of GSP implementation, TID is advancing several recharge initiatives, including an on-farm recharge pilot project, a Memorandum of Understanding with the City of Turlock to utilize the Dianne Storm Basin for recharge, and plans to install a pilot subsurface recharge system.

TID supplements surface water releases by pumping groundwater from drainage wells and rented wells. Drainage wells are owned by TID and are used to lower groundwater levels in localized, high groundwater areas and to supplement other irrigation water supplies. Rented wells are owned by private parties or Improvement Districts, and are rented by TID to supplement irrigation supplies, particularly in drier years when surface water supplies are limited. The specific wells that are rented each year vary depending upon a variety of factors, including the anticipated amount of rented pumping needed, pumping costs, condition of the well, and the quality and quantity of the water pumped. Water pumped from drainage wells and rented wells discharges either directly into a canal, into a pipeline that flows back to a canal, or into a pipeline that is utilized for irrigation purposes.

TID also utilizes supplemental groundwater pumping to help conserve water by reducing canal spillage. This is done by purposely releasing less surface water than is needed for irrigation into the head of each canal, and pumping groundwater into the lower sections of a canal to make up the difference. Utilization of available groundwater supplies in this manner provides greater flexibility to system operators to meet irrigation demand, while reducing distribution system spills. Recent pump automation has further facilitated this process, enabling many of TID's drainage pumps to be turned on and off remotely, reducing both groundwater pumping and spillage.

2.1.2.1 Improvement Districts

TID's responsibility for water delivery stops at the canal or lateral sidegate. Growers are responsible for the construction and maintenance of facilities to transport water from the TID canal to their land. Improvement Districts (IDs) are formed to allow groups of growers to pool resources to construct, operate and maintain these irrigation facilities, including ditches, pipes, wells, drip/micro irrigation systems, and surface and subsurface drainage facilities. TID offers low interest financing to IDs, generally with a 10-year loan term.

TID is the trustee and administrator for 1,062 IDs. To serve the 1,062 IDs, there are 250 deep well pumps, 1 booster pump, 62 drains and 749 irrigation ditches and pipelines that deliver water from the TID canals and laterals to individual growers. TID facilities comprise approximately 700 miles of lined delivery ditches and pipelines serving 124,000 acres. Generally, the District continues to work with IDs to use pipe facilities whenever possible. An average ID is comprised of 12 parcels with an average parcel size of 18 acres. The average parcel size receiving surface water within TID's irrigation service area is 27 acres. Parcels not belonging to IDs receive water through private pipelines and ditches served directly by sidegates on TID canals and laterals.

2.1.2.2 System Operational Constraints

There are a few capacity constraints in the TID distribution system that can cause delays in delivering ordered water. These capacity constraints are due, in part, to gradual changes in cropping patterns and irrigation systems over the years that have led to a demand for more frequent and time sensitive irrigation (e.g., a shift from irrigated pasture to corn and orchard crops, and a shift from flood irrigation to micro sprinkler and drip irrigation systems). To reduce delays in water deliveries and to improve customer service, TID processes irrigation orders and tracks current water use by parcel through its central Water Call Center (created in 1991) and its online ordering system (fully implemented beginning in 2014). TID also encourages irrigators

that use drip and micro sprinkler irrigation systems to install small reservoirs that can be more easily filled with surface water deliveries, and then drawn from by the grower's system for irrigation.

To meet delivery requests in constrained areas, TID also rents pumps to supplement surface water supplies downstream of the capacity constraint. Pumps are used as needed to ensure that the customer is not affected by system constraints and receives the full ordered flow with as much flexibility in timing as practical. The rented pumps that are turned on for this purpose can run continuously for up to several days per week during the summer peak demand time, until demand has diminished.

2.1.2.3 Changes to Service Area

Urban, rural residential, and semi-agricultural development has increased within TID's irrigated service area in the last several decades. Currently, there are approximately 20,000 acres of urban development, based on County land use maps. Other semi-agricultural and rural residential land uses occupy approximately 5,000 acres within the TID service area⁴. An evaluation of land use patterns in the TID service area completed in 2006 showed that idle cropland has gradually been converted to urban land uses, rather than land in active agricultural production. The economic downturn that began in about 2008 also influenced urban development in the region, a condition from which this area has been recovering. Recent analysis using the Cropland Collaborative Research Outcomes System application suggests that less than 3,000 acres have transitioned from agricultural to non-agricultural use since 2010. This indicates that land use shifts have not significantly impacted the overall extent of actively irrigated acreage within TID. Hence, land use changes within the irrigation service area have not resulted in significant reductions in active irrigated acreage since the early 2000s.

Several local community water systems have studied the possibility of using TID surface water from the Tuolumne River to supplement groundwater supplies. In 2015, the cities of Ceres and Turlock formed the SRWA to further develop the project, now known as the Regional Surface Water Supply Project (RSWSP). To ensure the availability of surface water for the RSWSP, TID and the SRWA executed a Water Sales Agreement (WSA) that determined the quantity of water that could be diverted from the Tuolumne River utilizing TID's water rights. The WSA also included provisions that the SRWA provide groundwater to TID's growers during times of drought, to help offset the surface water being provided annually. In June 2020, the SRWA voted to initiate design and construction of the Tuolumne River treatment plant serving Turlock and Ceres.⁵ Construction was finished in late 2023 and deliveries began in 2023. (See **Section 3.4** for more information regarding municipal and industrial water supplies.)

⁴ Rural residential and semi-agricultural land uses are summarized from 2016 Farmland Mapping and Monitoring Program data available from the California Department of Conservation, Division of Land Resource Protection. These land uses include land use classes R (rural residential land) and sAC (semi-agricultural and rural commercial land) in the TID service area.

⁵ Holland J. 2020. "Turlock and Ceres give final OK to river treatment plant, after 30-plus years of talk." *The Modesto Bee*, published July 1, 2020. <https://www.modbee.com/news/local/turlock/article243905272.html>

2.1.3 Terrain and Soils

Soils within TID vary from loam on the eastern edge of the irrigation service area to loamy sands on the western side. On average, land in TID is flat with an average fall of about 1 foot per 1,000 feet. Most irrigated lands in the TID irrigation service area are laser leveled, with the annual crop areas re-leveled every few years. The majority of land is flood irrigated using basin-check systems that generate little or no tailwater. As a general rule, private tailwater return systems are not permitted to discharge to the distribution system. Even on the eastern side of TID, where the land is somewhat steeper and more tailwater occurs, the majority of growers have control structures to prevent tailwater from flowing directly back into the distribution system.

A small quantity of tailwater is generated in the TID irrigation service area. Tailwater production is limited to approximately 10,900 acres (less than 7% of TID irrigable lands). The tailwater first flows to agricultural drains that collect a mixture of tailwater, shallow groundwater, and occasionally rainfall runoff. Several of these drains are intercepted by the distribution system, enabling recovery and reuse of drain flows, including tailwater from approximately 2,700 acres (less than 2% of TID irrigable lands). The remainder of drains flow to local rivers. During the irrigation season, the intercepted water is blended with surface water supplies in the canals and used for irrigation. Approximately 8,200 additional acres within TID can also produce tailwater, but this water does not enter the TID distribution system. (See **Section 2.2.1.4** for additional information regarding tailwater policies.)

On the western side of TID, localized perched water tables result from extensive clay lenses lying between 5 and 20 feet beneath the ground surface. These perched water tables developed soon after water was delivered into these areas in the early 1900s and led TID to begin installing drainage wells as electricity became available in the 1920s. The drainage wells in these areas are operated to help lower groundwater levels to maintain aerated root zones for crop production. TID makes monthly shallow groundwater elevation maps to guide the operation of the drainage pumps. Between 2015 and 2024, TID owned 153 drainage wells and generally operated between 107 and 127 of them each year depending on rainfall and need for drainage. The pumped drainage water can contain elevated concentrations of Total Dissolved Solids (TDS) and nitrates and is therefore blended with surface water then used for irrigation to the fullest extent possible.

The spatial variation in soils from east to west has resulted in the majority of the orchard crops being cultivated on the east side of TID, while the bulk of the field crops supporting the dairy industry are found on the west side. Micro sprinkler and drip irrigation systems are concentrated on the east side in the areas with lighter soils, and tend to use less water and produce less deep percolation (recharge) than surface irrigation methods. However, it should be noted that, where feasible, most new installations of drip irrigation and micro sprinkler systems use surface water and also maintain access to their historic flood irrigation facilities. The east side of TID is the area where recharge is most needed to overcome local groundwater level declines primarily resulting from groundwater pumping to the east of the TID service area, presenting a challenge to groundwater management in the Subbasin. Conversely, subsurface drainage systems have been installed in the western areas with higher groundwater levels.

2.1.4 Climate

TID’s service area is characterized by a Mediterranean-type climate. Summers are hot and dry, with average high temperatures over 90°F in July, and temperatures exceeding 100°F at times. Winters are cool and wet, with the majority of precipitation falling between November and March. The coldest months of the year are December and January, which have an average minimum temperature of 37°F. These characteristics are widely representative of the climate throughout the irrigation service area. Microclimates within TID do not vary greatly and, therefore, have little impact on TID operations or on-farm water demands. Average climate data for the period 2003 to 2024 are presented in **Table 2.3**. The twenty-two year period provides a reasonable depiction of long-term climatic conditions within TID. Potential climate change effects are discussed in **Section 6**.

Natural precipitation generally meets the water needs of winter annuals, pasture and winter cover crops in the orchards; however, dry winters may require irrigation deliveries for these crops between November and February. In the past, early irrigations have typically occurred within a two week period in either January or February. Water delivered during the winter is typically not counted towards a grower’s available water supplies (referred to as the “allotment” prior to 2013) for the irrigation season and is charged on a volumetric basis.

Although freezing temperatures do occur during the winter months at times, TID does not deliver water for frost protection. However, TID does allow pump owners to use the canals to convey their own deep well water to other parcels owned or rented by the pump owner. A condition of this use is that such activities cannot interfere with operation and maintenance of the canal or lateral.

Table 2.3. Average Climate Characteristics (2003-2024)

Climate Characteristic	Parameter	Average Value ¹
Precipitation (Inches)	Average Annual Precipitation	11.41
	Average Monthly Minimum Precipitation (August)	0.01
	Average Monthly Maximum Precipitation (January)	2.27
Temperature (°F)	Average Monthly Minimum Temperature (January and December)	37
	Average Monthly Maximum Temperature (July)	92
Reference Evapotranspiration (ET _o , Inches)	Average Annual ET _o	55.0
	Average Minimum Monthly ET _o (December)	1.1
	Average Maximum Monthly ET _o (July)	8.5

¹ Average values are from California Irrigation Management Information System (CIMIS) Station #168 (Denair) for 2003 - April 2009, and from CIMIS Station #206 (Denair II) for April 2009 - September 2024.

TID has been providing growers with local weather information for on-farm water management for nearly 23 years. In early 2002, TID installed the California Irrigation Management Information System (CIMIS) Station #168 (Denair). In April 2009, CIMIS Station #168 (Denair) was relocated approximately two miles to the southeast and assigned a new station number (#206). The station is currently located on an irrigated pasture with adequate fetch to provide reliable reference evapotranspiration estimates.

The station provides area-specific climate and reference evapotranspiration data to growers to allow them to effectively schedule irrigation events based on current and projected crop water usage. TID provides growers with the CIMIS website information and a web link to CIMIS tutorials and station data on the TID website (www.tid.org/irrigation/irrigation-information/). Growers can also access the data directly from the DWR website.

2.2 OPERATIONAL CHARACTERISTICS

2.2.1 Operating Rules and Regulations

The current TID “Irrigation Rules” are publicly available on the TID website (www.tid.org/irrigation). The Irrigation Rules include rules for the distribution and use of irrigation water, governing rules for IDs, pump IDs, and subsurface drainage IDs, and the TID Drainage Policy. Updates to the irrigation rules occur from time to time as needed. Any changes to the irrigation rules are communicated to customers and readily available at TID offices, or via the TID website (www.tid.org). The irrigation rules were last updated on October, 22, 2024 and are provided in **Appendix E**.

2.2.1.1 Water Allocation Policies

Historically, the TID Board of Directors has established the baseline water allotment each year depending on projected runoff including the possibility of the occurrence of consecutive dry years, desired carryover storage, flows required to be delivered to the lower Tuolumne River, and the availability of rented pumps. This baseline allotment was part of a three-tiered increasing block rate schedule, which is discussed in greater detail in **Section 2.2.3**, “Water Rate Schedules and Billing.” The baseline allotment was the quantity of water available equally to each acre of land within the TID service area. Additional water could be purchased, if available, and was charged on a volumetric basis. In average rainfall years, the baseline allotment was as high as 48 inches (4 AF per acre).

On June 12, 2012, the TID Board of Directors adopted a new volumetric pricing structure to comply with SBx7-7 water pricing requirements. As described in **Section 2.2.3**, the new structure is an increasing block rate structure combined with a fixed charge. Additionally, the structure includes two different fee schedules, one for “normal” water years and one for “dry” years. The new rate structure took effect in 2013. With the new structure, instead of establishing an “allotment,” the Board of Directors determines the amount of water available for purchase each year, and the fee schedule to be used (e.g., normal or dry year). These determinations are made based on projected runoff, including the possibility of the occurrence of consecutive dry years, desired carryover storage, flows required to be delivered to the lower Tuolumne River and the availability of rented pumps.

In establishing water available in a dry year, the District evaluates water supplies as if it is the first dry year of a multiple year dry cycle. For these analyses, the recent dry period from 2012 to 2016 is used as the drought of record for planning purposes. Other significantly dry periods are 1976 through 1977 and 1987 to 1992. These dry periods, and their impacts on water supply availability, are often utilized for reference in water supply planning. In the future, experience gained during the most recent 2021 through 2022 dry period will be incorporated into these water supply evaluations.

In years when TID growers receive a full allotment of surface water (48 inches), the sale of “replenishment water” is allowed to lands outside of TID. The bulk of the replenishment water goes to lands to the east of TID as a substitute for groundwater pumping or in lieu groundwater recharge. These lands have no surface water supply and groundwater pumping has caused a cone of depression to form on the eastern portion of the Turlock Subbasin. TID promotes in-lieu groundwater recharge during most years with normal or above normal precipitation by selling replenishment water at rates that are competitive with the cost to pump groundwater. The last time replenishment water was made available in 2024 and 2025, the cost was \$50 per AF.

2.2.1.2 Water Orders

TID uses an arranged-frequency demand system of water ordering and delivery. Under this system, the irrigation frequency (water delivery date) is arranged, flow rates are arranged subject to a maximum limit, and the delivery duration is under user control as growers are allowed to keep the water until they finish irrigating (ASCE, 1991). Cropping patterns in TID’s irrigation service area are very diverse, with trees, vines, alfalfa, and field crops often served by the same ID pipeline. An individual grower may adjust the duration and frequency of delivery and, less commonly, the flow rate to meet crop needs. For surface irrigation, flow rates are typically held constant from one irrigation event to the next to achieve consistent system performance.

Growers place orders for water with TID’s central Water Call Center, where a computer system tracks current water use by parcel. In addition, TID began implementing an online ordering system in 2011, with full implementation reached in 2014. The District has also made historical customer information available to growers online. Use of the new online system has been gradually increasing over time. In 2025, about 55% of orders were completed online.

In terms of delivery timing, growers typically received water within 44 to 48 hours after placing an order. Beginning in 2024, the District also introduced an “earliest delivery date” option, allowing for expedited service. Wait times for these orders are 18-24 hours. Growers are allowed to keep the water until the irrigation is complete. Growers are billed for the total volume of water used, computed from calibrated delivery flow rates and the actual time of use rather than the time estimate given when the water order was placed. As described under “Irrigation Deliveries” below, most growers take a full flow (or “head”) of water. The TID Water Distribution Operator (WDO) notifies each irrigator of the name and contact information of the grower they will receive the water from, and the grower they will pass the water to when finished.

Growers that irrigate with micro systems or sprinklers using non-standard flow rates (less than the full “head” typically used by surface irrigation) set up weekly orders in the central Water Call Center and then communicate directly with the WDO to coordinate delivery. The WDO has the discretion to adjust the grower sequence from the Water Call Center water requests. This is done to minimize flow fluctuations in long pipelines by sequencing in continuous 24-hour blocks rather than making multiple flow adjustments throughout the day. Fixed two week rotation deliveries are also established for up to approximately 600 “garden heads,” which are blocks of parcels typically 5 acres or smaller of non-commercial agriculture that are irrigated as a unit.

Wait times for water delivery are variable within a reasonable range, due to the discretion that WDOs have to adjust delivery sequences. The WDO must call the irrigator within 24 hours of

receiving the irrigation request to give an estimate of the delivery time. The WDO then will attempt to contact the irrigator at least 12 hours in advance to notify the irrigator of any change in time of delivery. Growers have received water approximately 44 to 48 hours after they placed an order in 2025. The grower is responsible for contacting the next irrigator in the sequence to let him or her know when the water will be available. The lead time, or notice, for the next irrigator is typically ½ hour to 1 hour before the preceding irrigation finishes.

The software system currently used by the Water Call Center to track water orders and irrigation deliveries and to bill customers is a proprietary system, referred to as the TXDB database, created by TID software engineers in the early 1990s. The system has been updated as needed over time. TID has chosen to modify the proprietary system to better track ordering, measurement, and billing data to meet the SBx7-7 requirements.

2.2.1.3 Irrigation Deliveries

The predominant irrigation practice in the TID service area has historically been and continues to be a basin-check flood irrigation system. In the last ten years, irrigators in TID have increasingly adopted micro sprinkler and drip irrigation systems. This shift has been driven primarily by increased production of orchard crops supported by these types of irrigation systems.

TID supplies water by gravity to growers at ID or private sidegates. Growers are responsible for controlling their water while irrigating, and for passing the entire flow on to the next grower, as instructed by the WDO.

The standard “head” of water delivered is generally 15 cubic feet per second (cfs), and TID requires new flood irrigation facilities to be designed for a minimum of 15 cfs. Growers served through private pipelines or ditches generally receive a full standard head for flood irrigation systems. In most instances, growers served from an ID pipeline or ditch also receive the entire flow in their sidegate in the order the water is scheduled. The availability of these large delivery rates has enabled high application distribution uniformity using surface irrigation on the light textured soils found in the majority of the TID service area.

The recent shift in irrigation methods is expected to continue and presents some challenges for TID operations. Drip and micro sprinkler irrigation systems generally require lower flow rates, ranging from 2-4 cfs on average, and require longer irrigation durations compared to flood irrigation systems. TID’s gravity system is designed to convey large flood heads, but the increased use of drip and micro sprinkler systems has increased demand for “microheads,” with lower, varying flow rates and longer durations. TID must accommodate these microheads either by carrying the microheads together with larger flood heads, or by combining the microheads, which is challenging for WDOs due to their varying start and end times. The added challenges of these microheads result in greater difficulty for WDOs to “level” demands by arranging the sequence of deliveries. Regulating reservoirs and canal modernization are being constructed by TID to respond to these challenges as the number of drip and micro sprinkler systems continues to increase.

2.2.1.4 Drainage and Tailwater Policies

As a general rule, direct tailwater discharges are not permitted in the TID distribution system. The basin-check, sprinkler and drip/micro irrigation systems used in TID’s irrigation service area

produce little or no tailwater. Overall, approximately 10,900 acres (less than 7% of TID's irrigable acreage) generates tailwater. A small portion is collected in drains and discharged into the distribution system where it blends with surface water and is reused for irrigation. The remainder flows to local drains, which in turn discharge to nearby rivers.

In 2000, TID began a systematic program to inventory the tailwater and storm drains that discharge to TID facilities. In 2004, TID received grant funding which allowed TID to complete the inventory for the entire District, and to provide financial assistance to growers for installing positive shut-off devices on their drains and for installing real-time water quality monitoring equipment. As part of this program, TID issues growers with drainage discharges a "Drainage Permit" which requires that a positive shut-off device be installed on each field drain, establishes a size limit on the drain and spells out the grower's responsibilities with respect to the quality of their drainage water. An annual fee is also charged for each field drain to offset a portion of the maintenance costs.

The inventory shows that drain water that eventually enters TID canals comes from a small percentage of lands within TID (approximately 2,700 acres, or less than 2%). This drain water includes tailwater mixed with other source water such as groundwater and natural runoff from precipitation. The drain water is blended with surface water supplies for delivery to TID growers. Some tailwater is generated on approximately 8,200 additional acres within TID but is not intercepted by the TID distribution system.

2.2.2 Water Delivery Measurements or Calculations

2.2.2.1 Conveyance System Measurements

TID began installing a Supervisory Control and Data Acquisition (SCADA) system in 1997, with data collection beginning in 1998. Through its agricultural management planning process, TID improved upon its SCADA system to better monitor flows by adding additional SCADA sites throughout the canal system. In 2007, TID began upgrading the pressure transducers originally installed with the SCADA equipment to maintain data accuracy and has since completed the upgrade at all sites.

Today, TID collects water measurement data from 493 SCADA sites, including nine miles of Rubicon Total Channel Control (TCC) automation and remote control systems for many of the District's drainage pumps. TID monitors upstream water levels, gate openings, and measured flows at regular intervals. Many of the recent installations have been Rubicon flume meters, which are designed to rotate locations for flexible monitoring, and Flume gates, which serve as drop-in replacements for flow or level control. Every canal head is now controlled by a Rubicon. TID also collects water measurement data from TID-owned drainage wells, tile drain systems that discharge water into TID laterals, and spill sites at the end of TID laterals and canals.

These improvements have increased TID's ability to monitor system operations. Staff routinely monitors flows at the heads of most laterals, main diversion points, 18 intermediate points in the distribution system, and at 14⁶ operational spillage sites, three (3) drains, and two (2) creeks.

⁶ There are 15 operational spillage sites in the TID system. However, only 14 are used. The 15th site can spill, but is very rarely used, and therefore is not included in the SCADA system at this time.

Further, WDOs have remote access to the real time flow data through a program installed on their TID tablet computers, allowing them to rapidly check conditions throughout their service area. The installation of SCADA technology has increased the availability of flow measurements throughout the TID distribution system. In addition to providing flow measurements at previously ungauged sites in the distribution system, the telemetry equipment replaced the Stevens chart recorders. The SCADA sites produce more accurate flow volumes because flows are recorded in real time and averaged for the daily flow volume. These flow data have improved the estimates of water use throughout the irrigation service area.

The measurement structures within the conveyance system are maintained annually to ensure the accuracy of recorded measurements. The calibration of the sensors at the SCADA sites is periodically checked throughout the year, and the SCADA data is regularly transferred into a data warehouse.

2.2.2.2 Delivery Measurements

The delivery point at which water is delivered from a TID canal or lateral to a grower's parcel or an improvement district facility is called a *sidegate*. Sidegates are typically operated for measurement by setting the valve stem opening as needed to deliver the standard irrigation flow rate (generally 15 cfs for flood irrigation). The valve opening is determined by measuring the height of the gate stem above a standard reference point on the gate frame. Historically, the gate opening has been set such that the end (downstream-most) user receives at least the standard flow for that pipeline.

The gate opening required to deliver the standard flow has been determined from flow measurements made by trained TID employees using portable electromagnetic velocity meters or ultrasonic flow meters, which measure velocity in the irrigation pipeline or ditch downstream of the sidegate. Flow is calculated by multiplying the measured velocity by the cross-sectional area of the pipe. The required gate openings to provide a standard 15 cfs head are provided to the WDOs, the field staff who deliver the water, and to the growers served by each gate. A gate opening and associated flow rate is assigned to each parcel in the database record used to compute water use.

TID also provides an increasing number of non-standard delivery rates, mainly to parcels served by pressurized systems. Deliveries to these parcels are assigned a unique flow based on the individual configuration of each particular sidegate-parcel-irrigation method-requested flow rate combination, referred to as the parcel-specific calibrated flow rate. The parcel-specific calibrated flow rate provides the required delivery measurement accuracy to be fully compliant with the delivery measurement accuracy standards specified in the California Code of Regulations Title 23 Division 2 Chapter 5.1 Article 2 Section 597 (23 CCR §597).

Growers are billed for the volume of water delivered. When a grower completes an irrigation event, they contact the WDO to give the start and stop times for the irrigation, and the WDO records the times on a water receipt. The volume delivered is calculated by multiplying the calibrated delivery flow rate by the duration of the delivery.

TID has developed a two-pronged approach to delivery measurement: 1) installing new measurement devices to directly measure the volume of water at sidegates with large delivery volumes and 2) establishing parcel-specific calibrated flow rates at the remaining sidegates.

Documentation of TID’s delivery measurement accuracy and accuracy improvement program is provided in **Appendix F** of this AWMP.

As of December 31, 2024, TID has installed 153 new continuous flow measurement devices with laboratory-certified flow rate accuracy on sidegates that together serve roughly half the irrigated acreage in TID.

At existing sidegates without access vents in suitable locations for measurement, TID developed a system for temporarily installing Rubicon FlumeMeters to determine the parcel-specific calibrated flow rates. In total, TID has used 129 mobile FlumeMeters in this program to develop calibrated flow rates at 507 existing sidegates that serve 1,210 parcels, representing 33,389 assessed acres, or approximately 21 percent of the District.

Additionally, Hach FH950 meters have been used to determine parcel-specific calibrated flow rates at 302 sidegates serving 471 parcels that together represent 17,474 assessed acres, or approximately 13 percent of the District. Finally, Fuji Portaflow meters have been used to determine parcel-specific calibrated flow rates at 366 sidegates serving 668 parcels that together represent 24,323 assessed acres, or approximately 21 percent of the District.

As of 2019, TID has finished initial calibrations per the corrective action plan for active sidegates that don’t fall under DWR exemptions. In total, across all field testing methodologies, 100% of the assessed acreage served by the non-exempted active sidegates now receive calibrated delivery flow rates.

Plans for future flow measurements and calibrations are described in **Appendix F**. As TID moves forward with collecting additional flow measurements, TID will prioritize the sidegates in the random samples found to have a flow rate accuracy that is outside of the acceptable range to meet SBx7-7 requirements. These measurements will be collected to improve the accuracy of the average flow rate used as the calibrated flow rate for the sidegate-parcel-irrigation method-requested flow rate combination. TID will also provide new calibrations, as needed, to serve new flow requests from customers.

2.2.2.3 Private Pumping Measurements

Private pumping volumes in TID are estimated using a conversion factor that correlates the quantity of water pumped with electrical energy use. TID has reviewed and revised the conversion factor on several occasions. Revisions to this methodology have helped to improve the accuracy of private pumping volumes and to prevent overestimation resulting from other electricity usage associated with the same electric meter. TID will continue to review and revise the conversion factor in the future, as needed.

2.2.3 Water Rate Schedules and Billing

TID historically used a three-tiered, increasing block rate schedule based on three classes of water deliveries. The first block was the annual allotment which was available equally to each acre of land. The volume of the allotment varied depending upon the available surface water supply. The actual allotment, as well as any additional water available above the allotment, was set each year based on projected runoff including the possibility of the occurrence of consecutive

dry years, carryover storage, flows required to be delivered to the lower Tuolumne River and the availability of rented pumps.

TID's historical pricing and water management practices enabled TID to conjunctively manage its surface water and groundwater resources. In normal and above normal water years, allotments (up to 48 inches per acre; now termed "available water") encouraged growers to use surface water rather than pump groundwater. Surface water applied but not consumed by the crop recharges the groundwater system. The recharge maintains groundwater storage that is pumped in dry years to supplement reduced surface water supplies. Additionally, the allotment was reduced in dry years, increasing the cost to the grower by moving deliveries into the higher tiered water prices sooner. This not only encouraged conservation in dry years but also provided additional revenue to cover costs associated with additional pumping needed to supplement reduced surface water supplies.

In June of 2012, TID adopted a new volumetric pricing structure that became effective in 2013. This structure is designed to continue to support the District's critically important conjunctive management objectives, but also to comply with the requirements of SBx7-7. The new structure included a fixed (per acre) charge, combined with a four-tiered increasing block rate schedule. The new rate structure also includes a split schedule, with one schedule established for dry years, and another for normal or above normal years. As with the previous pricing structure described above, the new "dry" schedule is at a higher rate, to help recover the additional pumping costs incurred in dry years. With the new pricing structure in place, the TID Board of Directors no longer determines the allotment each year. Instead, the Board determines the type of water year (and therefore the water pricing schedule to be used for the given year) as well as the amount of water available for purchase, based on projected runoff, including the possibility of the occurrence of consecutive dry years, carryover storage, flows required to be delivered to the lower Tuolumne River and the availability of rented pumps. The process now used to determine the volume of available water is similar to that used previously to establish the annual "allotment."

The current irrigation rate schedule (shown in **Table 2.4**) was adopted by the TID Board of Directors in 2025 and has been in effect since the start of the 2025 irrigation season. This marks the first rate adjustment since 2015, when the 2013 rate schedule (described above) was updated to fund system improvements and operating costs. Beginning in 2025, the Board approved a 6.2% rate increase over three years, with approximately 2% applied annually. In addition to the rate adjustment, structural changes were introduced: Tiers 1 through 3 have been consolidated into a single rate, set at \$2.70 in 2025, \$3.23 in 2026, and \$3.83 in 2027. Tier 4 remains unchanged at \$20 per acre-foot, and the Fixed Charge for both normal and dry year types also remain the same. This updated structure continues to support the District's critically important conjunctive management objectives, and to comply with the SBx7-7 requirements.

In addition to the cost of water, the growers are responsible for the cost of the facilities to convey water from the TID canal sidegates to their fields.

TID also promotes in-lieu recharge in most years with normal and above normal precipitation. In years when TID growers receive a full allotment of surface water (48 inches), the sale of replenishment water is allowed to lands outside of TID. The bulk of these sales go to lands to the east of TID as a substitute for groundwater pumping for irrigation. These lands have no surface

water supply, and groundwater pumping significantly impacts available groundwater supplies in the Subbasin. The District promotes groundwater recharge in those areas in years when surplus water is made available by selling the water at rates comparable to the cost to pump groundwater. Replenishment water was last available in 2024 and 2025 at the cost of \$50 per AF.

Table 2.4. Description of 2025 Water Rates (Adopted in 2025).

Water Charge Basis	Each year, based on water supplies available, the Board determines the amount of water available, and whether the normal or dry schedule is to be used.	
Acreage-based ¹	Fixed charge on an acre basis, varies by normal or dry year	
Quantity-based	Water charged on a per acre-foot (AF) basis, varies by normal or dry year	
Type of Billing	Water costs include a fixed charge for access to water, plus volumetric charges for the water used. Charges are established in normal or dry year schedules. Volumetric charges increase for volume delivered greater than the available water volume.	
	Normal Year Rate Schedule¹	Dry Year Rate Schedule¹
Fixed Charge	\$60 per acre	\$68 per acre
Available Water Rate	\$2.70 per AF, up to available water	\$2.70 per AF, up to available water
Water Rate Over Available Water	\$20 per AF, over available water	\$20 per AF, over available water
Frequency of Billing	Semi-annually	

¹Acreage based on assessed acres.

2.2.4 Water Shortage Allocation Policies and Drought Plan

TID’s water allocation guidelines were developed in response to the 1987-1992 drought and were reevaluated following the 2012-2016 and 2021-2022 droughts. The water allocation guidelines are described in greater detail in TID’s Drought Management Plan (**Appendix G**). The guidelines rely on TID’s groundwater pumping capacity and management of carryover storage in Don Pedro Reservoir. Prudent water supply planning requires TID to consider that the first dry year encountered may just be the first year in a series of dry years similar to the 1987-1992 or the 2012-2016 drought periods.

Prior to 2013, the Board of Directors determined the available water and carryover storage each year based on runoff projections, the possibility of the occurrence of consecutive dry years, existing carryover storage, availability of groundwater and rented pumps, and instream flow requirements. The decision was made either to set the available water (or “allotment” prior to 2013) at normal levels, or to reduce the available water consistent with lower surface water diversions. Groundwater pumping was increased progressively in the first years of a drought, while the available water was progressively reduced. The gradual increase in groundwater use and corresponding decrease in water available to growers allowed for a more uniform increase in groundwater pumping balanced against annual reductions in the carryover storage reserve. Additional pumping and other operational changes helped to reduce spills, further extending limited supplies. However, there is a limit to the amount of pumping the District is able provide.

As a drought continued, growers with access to private wells were able to use them to offset reduced District supplies.

The reduction in available water in the first drought years caused growers to go into the higher priced additional water above the available water, and was intended to promote water conservation at the farm and supplier scales⁷. For subsequent years of drought, the same process was used to make further adjustments in the water available and carryover storage. In critically dry or consecutive dry years, TID could cap water deliveries to lands receiving surface water. Historically, the one exception was that growers that rented pumps to TID were typically given access to an additional 12 inches of water, up to a maximum of 48 inches, on those lands able to be served by the pump. This was done to encourage growers to rent pumps to TID. Without this option, many rental pumps may not have been available, significantly reducing TID's ability to supplement reduced surface water supplies in dry years.

Beginning in 2013, a new water rate structure in response to SBx7-7 changed the process described above. In 2025, the TID Board of Directors approved its first rate increase in a decade. The current Irrigation Rate Schedule, adopted at the start of the 2025 irrigation season, includes separate schedules for normal and dry years. Each schedule consists of a fixed charge per acre and volumetric water charges. However, a similar type of water shortage allocation process has been implemented. In water short years, the Board of Directors determines whether to use the dry year rate schedule and the amount of water available on a per acre basis, based on projected runoff including the possibility of the occurrence of consecutive dry years, carryover storage, flows required to be delivered to the lower Tuolumne River, and the availability of rented pumps.

As with past years, the decision to reduce surface water diversions in the future will be made based on available water supplies. Information including runoff and carryover storage projections, the availability of rented pumps, and instream flow requirements will be used to assist in making that determination. Similarly, groundwater pumping is expected to increase progressively in each drought year as supplies allow, and water available to the growers may be progressively reduced, as needed to balance supplies available with carryover storage requirements.

However, even with TID's conjunctive water management, groundwater is not an unlimited supply. In accordance with the Sustainable Groundwater Management Act of 2014 (SGMA), local agencies must work together to achieve sustainable groundwater use in the Turlock Subbasin by 2042. TID has been actively involved in preparing the Turlock Subbasin Groundwater Sustainability Plan (GSP) which identifies the actions needed to achieve groundwater sustainability. The GSP was formally adopted by the Subbasin's Groundwater Sustainability Agencies (GSAs) at a public hearing on January 6, 2022, and was subsequently submitted to DWR. In January 2024, DWR deemed it incomplete. A revised GSP was submitted and subsequently approved on February 27, 2025. Following completion of GSP implementation efforts, groundwater is expected to generally remain available for use even during drought years because of recharge in normal and wetter years. As part of the GSP implementation, the Turlock

⁷ To develop a methodology to quantify Water Use Efficiency (WUE), DWR considered the components of a water balance at three spatial scales—basin, water supplier, and field (DWR, 2012). Similarly, spatial scale must be considered when evaluating the influence of the amount of water available to growers.

Subbasin GSAs are also implementing a Well Mitigation Plan, to address adverse impacts on drinking water wells caused by declining groundwater levels. The GSAs are partnering with Self-Help Enterprises to support outreach, program development, coordination, and response services. TID is also actively contributing to developing recharge projects within the district and providing replenishment water, when available, to other GSAs in the subbasin.

Water availability is treated equally for all crop types because a large proportion of field crop production occurs in conjunction with local dairy operations. This demand is as stable as the water demands for orchard crops. In the past, growers who paid the District's water charge were provided with access to the same amount of available water, regardless of crop type. The current rate schedule is designed to act in a similar manner. Payment of the fixed charge provides growers with access to purchase the amount of water available that year, regardless of crop type. All water delivered is charged on a volumetric (per acre-foot) basis.

Increased groundwater pumping during dry years also allows TID to increase water delivery efficiency by reducing operational spills. The use of extensive pumping allows a WDO to more closely match water supplies to demands in the downstream portion of a service area. This flexibility was utilized during the 1987-1992 drought, resulting in a substantial decrease in operational spills. TID has continued to rely on the practice of increased groundwater pumping to reduce spills in the dry years since the 1987-1992 drought, most notably 2007 through 2009 when operational spills were decreased to an average of five percent. Similarly, from 2012 through 2016 operational spills were progressively decreased each year to approximately five percent in 2014 through 2016. In the 2020-2022 drought, spills were similarly reduced.

2.2.4.1 Wasteful Use

TID's Irrigation Rules (**Appendix E**) require that all water be applied efficiently and used in a reasonable and beneficial manner (Rule 4.2.1). During an irrigation delivery, the irrigator is responsible for the water at all times after it leaves the TID distribution system (Rules 4.1.3 and 4.1.4). Irrigators who waste water intentionally or as a result of carelessness, improper field preparation, or neglected facility maintenance may be refused TID water until the cause of the condition is remedied (Rule 4.2.2).

The predominant irrigation method in TID (basin-check flood irrigation system) promotes beneficial use of water. Deep percolation that does occur from the basin-check systems provides recharge that is put to beneficial use by TID and its customers, as well as others within the Subbasin that rely upon groundwater for their water supply. As noted in the introduction to this AWMP, even with the recharge provided by irrigation, the groundwater levels in the eastern portion of TID and in the eastern portion of the Turlock Subbasin have steadily declined (see **Section 4.1.2**), largely due to groundwater usage outside the eastern boundary of TID.

It is important to note that in areas where groundwater levels are higher and groundwater is pumped for drainage, the drainage water is blended with canal water and used as a part of the irrigation supply. Drawdown of groundwater levels due to the cone of depression on the eastern side of the Subbasin limits the amount of groundwater that can be pumped on the eastern side of the District in dry years. However, the District is able to maximize the use of higher groundwater levels on the western side of the Subbasin for beneficial use.

2.2.4.2 Enforcement of Irrigation Rules and Regulations

Enforcement of the Irrigation Rules and the appeal process available to growers are described in detail in the TID Irrigation Rules in Part I, Section 10 (**Appendix E**). Failure or refusal to comply with the TID rules and regulations by a landowner or irrigator may lead to termination of water delivery (Rule 10.1). Once terminated, water delivery cannot be resumed to the landowner or irrigator until the issue is resolved.

The Water Distribution Department Manager is authorized to issue a Notice and Order or an oral or written warning to any irrigator or landowner in violation of a TID rule or regulation (Rule 10.2.1). The landowner or irrigator has ten calendar days from the date of service (of the Notice and Order) to file a written appeal to the General Manager or Board of Directors, depending on the type of notice, after which all rights to a hearing are waived (Rule 10.2.2). Water deliveries may be terminated immediately in certain circumstances (Section 10.3).

Once an order or decision has become final, the irrigator or landowner has seven calendar days to commence corrective action or repair and must pursue the action with sufficient diligence to meet the time established for compliance (Rule 10.5.4). When the landowner or irrigator re-establishes full compliance with all regulations, the eligibility to receive water deliveries is restored.

3. Description of the Quantity of Water Uses

This section of the AWMP describes the quantities of water used within the TID service area. As described in **Section 2**, the District co-owns Don Pedro Reservoir with Modesto Irrigation District (MID). The reservoir is outside of TID's service area and is managed by TID and MID for water storage, power generation, and recreation (including water sports). TID supplies irrigation water for agriculture. TID also provides domestic drinking water (in conjunction with MID) for the community of La Grange. These and other water uses within TID's service area, as well as uses related to TID's operations, are described in greater detail in the remainder of this section.

In **Section 3** (Quantity of Water Uses) and in the following **Section 4** (Quantity and Quality of Water Resources), the following periods are used for the presentation and interpretation of water use and supply data:

1. **2020-2024 Period (Near-Term Historical):** The 2020-2024 data are reflective of recent TID operations and weather conditions. During this period, the first three years are considered dry and the last two are considered normal.
 - a. Average: average annual value over 2020-2024, the last five years of operation.
 - b. Minimum and Maximum: minimum and maximum annual values over 2020-2024, depicting the range of values under recent historical conditions.
2. **2014-2024 Period (Long-Term Historical):** The 2014-2024 data are reflective of longer-term historical TID operations and weather conditions.
 - a. Average: average annual value over the 11-year period from 2014-2024.
 - b. Normal year average: average annual value for years in which water supplies were sufficient to allow for 48 inches or more of available water to each acre of land. From a hydrological perspective, these years could be characterized as anywhere between normal and wet. Over the 11-year period from 2014-2024, 5 years fall into this category.
 - c. Dry year average: average annual value for years in which water supplies were reduced, and the water available to each acre of land was less than 48 inches. Over the 11-year period from 2014-2024, 6 years fall into this category. The available water in these years ranged from a low of 18 inches (2015) to a high of 42 inches (2020).

Water uses and water supplies within these AWMP sections are summarized on a calendar year basis to include a complete irrigation season, thus better describing irrigation practices and TID operations that support those practices. The typical irrigation season in TID extends into October and occasionally November, straddling two DWR-defined water years (October 1 to September 30). Water year summaries of the complete TID water budget are included in **Appendix H**.

3.1 AGRICULTURAL WATER USE

The TID service area covers a gross area of 197,261 acres, with approximately 157,800 acres that can currently be irrigated with surface water. Between 2020 and 2024, the average assessed acreage in TID was 139,922 acres. This translates to an average of approximately 131,774 irrigated acres when an estimate of field roads and other small non-irrigated areas are accounted for.

The climate and soils in the TID service area are suitable for a wide variety of crops (approximately 36 different crops were grown during the 11 years from 2014 through 2024). **Table 3.1** lists the types of crops grown in the TID irrigation service area, and summarizes the average acreage planted of each between 2020 and 2024, and over the 2014 to 2024 period for both normal years⁸ and dry years. The minor differences in average acreages for normal and dry years reflect the high water supply reliability achieved by TID’s conjunctive management approach to water resources management. This high water supply reliability is also reflected in the large areas of permanent crops and crops supplying local dairies that require a steady water supply year after year. Permanent crops and crops that could be used to support local animal production together span approximately 126,000 acres, or approximately 96% of irrigated land within the TID service area⁹. The values in **Table 3.1** represent irrigated acreages with double cropping included as a specific crop type. Thus, double counting of acres is avoided.

Annual crop water use is summarized in **Table 3.2** for representative crop groups. Daily crop water use, or crop evapotranspiration (ET_c), is calculated for each crop group using the “crop coefficient – reference crop ET” methodology (Allen et al., 1998). In this process, the daily evapotranspiration from a known reference crop surface (ET_{ref}) is first calculated using local weather data. Then, daily ET_{ref} values are adjusted to represent the unique and varying daily ET_c rates of other crops throughout their growing seasons using specific crop coefficient (K_c) curves.

Improved, local crop coefficients have been developed for the TID water balance (described in **Section 5**) that reflect actual, observed water use characteristics of crops within TID. Daily crop coefficients were derived from actual crop evapotranspiration (ET_a) estimates calculated using remotely sensed surface energy balance results over nine recent years. Two surface energy balances were applied to calculate ET_a in TID: Mapping EvapoTranspiration at high Resolution with Internalized Calibration (METRIC) and Surface Energy Balance Algorithm for Land (SEBAL). METRIC and SEBAL results both account for the many factors that impact ET_c , including crop age, vegetation density, disease, salinity, deficit irrigation, and other stress factors.

⁸ Note that “normal” years, as described herein may include relatively wet years with respect to overall hydrology. As noted previously, for purposes of discussion, normal years refer to those years with 48-inches of available water.

⁹ Combined total of approximately 65,000 acres of permanent orchard and vineyard crops (2020-2024 average), and approximately 60,000 acres of alfalfa, pasture, sudan, corn, unirrigated forage/corn, oats, oats/corn, clover, grain, sorghum, and double-other crops that could be used to support animal production (2020-2024 average). The latter crops are available to support approximately 8,260 acres of confined animal agriculture facilities in TID (Farmland Mapping and Monitoring Program 2020 data for Stanislaus and Merced Counties, California Department of Conservation Division of Land Resource Protection).

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Quantity of Water Uses

Table 3.1. Irrigated Area¹ of Crops Grown on Lands Receiving TID Surface Water

Crop	ET Crop Group	Normal Year ³ Average	Dry Year ³ Average	2014-2024 Average	2020-2024 Average
Almonds	Almonds	54,151	53,277	53,675	55,550
Oats corn	Corn	18,357	9,596	13,578	18,505
Unirrigated forage corn ²	Corn	12,696	22,429	18,005	11,774
Corn	Corn	10,758	11,175	10,986	10,436
Alfalfa	Alfalfa	8,776	9,573	9,211	8,726
Walnuts	Other Trees	5,123	5,690	5,432	5,056
Pasture	Pasture	5,156	5,415	5,297	4,845
Double--other	Corn	4,988	4,485	4,714	4,133
Peaches	Other Trees	2,968	2,997	2,984	2,716
Sweet potatoes	Sweet Potatoes	2,468	2,137	2,288	2,236
Lawn	Pasture	1,342	1,535	1,447	1,546
Oats	Corn	1,509	1,142	1,309	1,412
Other crops	Other Crops	1,016	520	745	1,056
Sudan	Other Crops	637	1,200	944	799
Melons	Other Crops	554	352	444	557
Vineyard	Vineyard	601	890	759	421
Apples	Other Trees	440	448	444	405
Cherries	Other Trees	410	420	416	399
Other trees	Other Trees	337	359	349	357
Beans	Corn	289	188	234	199
Grain	Corn	74	126	102	150
Sorghum	Corn	51	86	70	133
Tomatoes	Other Crops	92	4	44	89
Olives	Other Trees	78	85	82	78
Garden	Other Crops	86	87	86	64
Pumpkins	Other Crops	49	43	46	26
Clover	Alfalfa	29	25	27	20
Onions	Other Crops	16	5	10	16
Citrus	Other Trees	8	12	10	13
Peas	Other Crops	10	2	6	13
Christmas	Other Trees	5	7	6	10
Sunflowers	Corn	8	0	4	8
Pears	Other Trees	7	7	7	7
Eggplant	Other Crops	4	5	5	6
Berries	Other Crops	3	12	8	4
Plums	Other Trees	4	4	4	4
Beets	Other Crops	0	2	1	3
Apricots	Other Trees	1	1	1	1
Squash	Other Crops	4	0	2	1
Total		133,105	134,341	133,782	131,774

¹ Irrigated area estimated as 94 percent of the assessed area (to account for farm roads and non-irrigated areas). Due to rounding of individual crop acres, totals may differ slightly from 94 percent of assessed area.

² Unirrigated (rainfed) forage followed by irrigated corn in a double cropped sequence.

³ Normal and Dry year averages from 2014-2024

Table 3.2. Calendar Year ET¹ in Inches for Crops Receiving TID Surface Water

ET Crop Group ²	2020-2024 Average	2014-2024 Average	Normal Year Average	Dry Year Average
Alfalfa	46.0	46.0	44.8	46.9
Almonds	40.1	40.2	39.3	40.9
Corn	38.8	39.1	38.4	39.6
Other Crops	37.9	38.2	37.4	38.8
Other Trees	37.3	37.5	36.7	38.1
Pasture	41.7	41.7	40.7	42.6
Sweet Potatoes	26.1	26.5	26.3	26.6
Vineyard	25.9	26.1	25.5	26.7

¹ Total ET from applied water and precipitation calculated with crop coefficients derived from a remotely sensed surface energy balance inherently account for "bare spots and reduced vigor" to represent the total water consumed.

² See Table 3-1 for crops included in the various ET Crop Groups

Studies by Bastiaanssen, et al. (2005), Allen, et al. (2007), Thoreson, et al. (2009), Allen, et al. (2011), and others have found that seasonal ET_a estimates by these models are expected to be within plus or minus five to fifteen percent of actual ET when performed by an expert analyst.

The seasonal crop water use totals summarized in **Table 3.2** were calculated using these local, daily crop coefficients and daily reference evapotranspiration (ET_o) rates reported by the CIMIS stations summarized in **Table 2.3**. The resulting daily ET_c rates are input to the physically-based Integrated Water Flow Model Demand Calculator (IDC) version 2015.0.0036 (DWR, 2015) to parse the relative fractions of total ET_c that are supplied by irrigation (ET of applied water, or ET_{aw}) and by precipitation (ET of precipitation, or ET_{pr}). As described in further detail in **Section 5**, IDC utilizes these inputs, as well as precipitation, soil parameters, and crop characteristics, to model inflows and outflows through the root zone on a daily time step. This approach ensures the most accurate and consistent calculation of historical ET_c and ET_{aw} possible and improves the reliability of the water balance and related performance indicators. Other relevant model input parameters and data sources are discussed in **Section 5**.

Table 3.3 summarizes the relative fractions of total ET_c that are represented by ET_{aw} and ET_{pr}. ET_{aw} is met by applied irrigation water that is delivered by TID, or that is privately pumped by irrigators. Water delivered by TID is a mixture of surface water releases from Turlock Lake, groundwater supplied by TID drainage pumping and/or rented well pumping, and recycled water supplied by tilewater drainage and spillage recovery. **Section 5** summarizes the annual volumes of each source. Precipitation that falls in the TID service area supplies ET_{pr} and contributes to deep percolation, runoff, and change in root zone storage.

Table 3.3. TID Calendar Year ET of Applied Water (ET_{aw}), ET of Precipitation (ET_{pr}), and Crop ET (ET_c).

Year	Year Type	ET _{aw} (AF)	ET _{pr} (AF)	ET _c (AF)
2020	Dry	371,332	57,119	428,451
2021	Dry	412,546	56,427	468,973
2022	Dry	412,326	49,418	461,744
2023	Normal	321,091	101,577	422,668
2024	Normal	302,885	83,652	386,537

Year	Year Type	ET _{aw} (AF)	ET _{pr} (AF)	ET _c (AF)
2020-2024	Average	364,036	69,639	433,675
	Minimum	302,885	49,418	386,537
	Maximum	412,546	101,577	468,973
2014-2024	Average	365,641	75,661	441,302
	Normal Year Avg.	339,100	90,932	430,032
	Dry Year Avg.	387,758	62,936	450,694

Table 3.4 summarizes the relative number and volume of irrigation deliveries supplied by TID according to irrigation method. Among all fields that receive surface water in the TID service area, the predominant irrigation practice is a basin-check flood irrigation system. Flood irrigation systems are used to irrigate virtually all types of crops in TID, especially alfalfa, pasture, corn, and various grains. TID also provides an increasing number of deliveries to parcels served by pressurized systems, including drip and sprinkler systems. Pressurized systems are largely used to irrigate almonds, other permanent orchard and vineyard crops, as well as sweet potatoes, and specialty crops.

Annual volumes of surface water supply, surface water deliveries, and estimated private groundwater pumping are summarized in **Section 4.1** and **Section 5**. Between 2020-2024, TID delivered an estimated average of approximately 405,650 acre-feet of surface water each year. Over the same period, groundwater pumping from private wells in the TID service area was estimated to extract approximately 79,900 acre-feet per year. Surface water deliveries were estimated as the closure of the TID canal system water balance, while private groundwater pumping was estimated based on power meter records for individual wells multiplied by a power factor derived from pump tests.

Table 3.4. Summary of Irrigation Deliveries by Irrigation Method for Crops Receiving TID Surface Water.¹

Period	Irrigation Method	Number of Deliveries	Percent Total Number of Deliveries (%)	Delivery Volume (AF, rounded)	Percent Total Delivery Volume (%)
2020-2024	Flood	35,695	65%	305,545	81%
	Sprinklers	3,878	7%	18,806	5%
	Drip/Micro	15,444	28%	51,598	14%
	Total ¹	55,017	100%	375,949	100%
2014-2024	Flood	35,028	67%	295,247	82%
	Sprinklers	3,965	8%	20,767	6%
	Drip/Micro	13,276	25%	42,983	12%
	Total ¹	52,269	100%	358,996	100%

¹ Summary of total deliveries reported in TID delivery records, excluding replenishment water deliveries, deliveries with unlabeled or inaccurately labeled irrigation methods, and deliveries with no recorded volume.

Besides irrigation, other uses of applied water include leaching of salts and frost protection for orchards and vineyards. The use of TID's agricultural water supply is to irrigate crops, while these other uses are limited and would be supplied privately. Due to the generally low salinity of TID irrigation water, the required leaching fraction is small for the crops grown in the District. Growers that irrigate crops using groundwater of relatively higher salinity could require

leaching to maintain production for sensitive crops. Similarly, frost protection may be necessary in certain circumstances. Frost protection is typically applied outside of the irrigation season and, although not provided by TID, growers may use private or ID wells as water sources for frost protection.

3.2 ENVIRONMENTAL WATER USE

There are no natural environmental resource delineations within the irrigation service area that are supported by TID diversions. However, the Federal Energy Regulatory Commission (FERC) license requirements for Don Pedro Reservoir include an extensive set of minimum instream flow release requirements that vary with the water year type. Instream flows and irrigation releases come from the Don Pedro Reservoir supplies. Releases to the Tuolumne River for environmental purposes therefore reduce the remaining supplies available for irrigation. In 1996, instream flow requirements were significantly increased. The annual volume of these flows ranges from 94,000 acre-feet in dry years to 301,000 acre-feet in wet years, up from 64,000 acre-feet and 123,000 acre-feet under the previous license requirements for dry and wet years, respectively. TID contributes approximately 68 percent of these releases. Diversions for irrigation are made after the instream requirements are met. (Note: The FERC dry and wet year distinctions described in this paragraph are based on regulatory requirements and are different than other hydrologic water year descriptions referenced in this AWMP.)

During a 45-day period between October 15 and December 1 (e.g., October 17 through November 30), flow fluctuations in the Tuolumne River are minimized to protect fall-run Chinook salmon. For the period extending from October 15 through March 15, river flow changes are also subject to certain ramping rates to protect salmon, which can require additional flows.

After successful completion of construction and commissioning of the water treatment plant, water transmission pipelines, and local water distribution system improvements, the Stanislaus Regional Water Authority project (SRWA, described in **Section 3.4**) began treating and delivering potable water to the Cities of Ceres and Turlock in December 2023. The flows requested by the SRWA (that are diverted at the infiltration gallery just downstream of the Geer Road Bridge) provide additional instream flows and added environmental benefits in the stretch of the Tuolumne River between the La Grange Dam and Geer Road.

3.3 RECREATIONAL WATER USE

While there are recreational uses of TID diversions, there is no mandated supply dedicated to recreational use, nor are the current recreational uses consumptive in nature.

The State of California Department of Parks and Recreation manages recreation at Turlock Lake as a part of the California State Park System (www.parks.ca.gov/?page_id=555). During the irrigation season, the water level in the lake is generally kept between water levels corresponding to 28,000 and 32,000 acre-feet of water to allow recreation along the shoreline and to ensure steady deliveries to the distribution system. During consecutive dry years TID may lower the operating lake level in order to reduce seepage. By the end of the irrigation season, the lake is drawn down to allow for maintenance and to provide stormwater capacity for the McDonald Creek watershed, which drains into the Upper Main Canal. The lake is used for duck hunting

and other recreational uses conducive to the lower reservoir levels typical of the non-irrigation season.

3.4 MUNICIPAL AND INDUSTRIAL WATER USE

TID, in conjunction with MID, operates the La Grange Domestic Water System serving 66 connections. Total water use is approximately 30 acre-feet per year, based on data available beginning in 2010 after water meters were installed. This use occurs upstream of Turlock Lake and is therefore not included in the TID water balance. Other municipalities, industries, and small domestic uses of water in the TID service area rely on groundwater for their supply, and it is expected that this groundwater use will increase over time.

However, in July 2015, Turlock Irrigation District (TID) and the Stanislaus Regional Water Authority (SRWA) executed a Water Sales Agreement, representing a significant advancement in TID's provision of surface water for municipal use. Under the agreement, TID committed to provide up to 30,000 acre-feet (AF) of surface water annually for the SRWA's Regional Surface Water Supply Project. Surface water is diverted from the Tuolumne River through an infiltration gallery near Geer Road, treated at a newly constructed regional water treatment facility, and distributed to participating communities.

TID prepared and submitted a change petition to the State Water Resources Control Board (SWRCB) to authorize use of its post-1914 water rights for transfer to the SRWA. In April 2020, TID and SRWA executed Amendment No. 1 to the original 2015 Water Sales Agreement. Among other provisions, the Amendment affirms TID's sole discretion to deliver water to the SRWA using its pre-1914 water rights, its post-1914 water rights, or a combination of both. The Amendment also clarified the use of certain TID-owned facilities and the allocation of ongoing operations and maintenance responsibilities for these facilities.

Substantial progress was achieved to advance the project following execution of the agreement and its amendment. The SRWA secured \$31.5 million in grant funding and obtained a low-interest loan through the State of California's Clean Water State Revolving Fund (SRF) program to finance the majority of project costs. In June 2020, the SRWA awarded a contract to CH2M Hill for design and construction of the Tuolumne River treatment plant serving the cities of Turlock and Ceres.

Construction of the treatment plant and related facilities was completed in 2023, and deliveries of treated surface water commenced that same year. The project provides a reliable municipal surface water supply, reduces dependence on groundwater pumping, and contributes to in-lieu recharge of the Turlock Subbasin.

The uses of groundwater described in this section are not directly included in the TID Water Balance as they are not a part of the TID system. However, the municipal, industrial and small domestic use of groundwater does have a potential to influence the groundwater supplies available for irrigation purposes in the future.

3.5 GROUNDWATER RECHARGE USE

Groundwater recharge is an important component of TID's conjunctive management strategy to achieve water supply reliability. As described further in **Section 4**, TID is a leader in

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groundwater management in the Turlock Subbasin. Most of the groundwater recharge within the Subbasin occurs indirectly as a result of agricultural practices in the irrigation service area. The discussion of conjunctive management in **Section 4** demonstrates how TID encourages the use of available surface water supplies and reduced groundwater pumping in normal years, resulting in significant in-lieu groundwater recharge. Groundwater recharge that occurs within TID consists of passive seepage from TID canals and facilities, as well as deep percolation of precipitation and applied irrigation water. The combined recharge is widely distributed across the TID service area and provides a means to replenish the Subbasin to the benefit of TID water users, communities within TID, and surrounding areas that share the groundwater resource.

Estimates of groundwater recharge from these sources were derived from the water balance analysis described in **Section 5**. Canal seepage was calculated based on soil characteristics and the canal wetted perimeters, overall lengths, and wetting frequency. Deep percolation of irrigation water was calculated as the closure term¹⁰ of the TID irrigated lands water balance accounting center (described in **Section 5**). Deep percolation of precipitation was calculated based on daily results of the IDC root zone water balance model (introduced in **Section 3.1** and described further in **Section 5**). Annual seepage and deep percolation volumes for 2020 to 2024 are provided in **Table 3.5**, along with total recharge expressed as a volume and as a depth of water relative to the district's gross acreage (197,261 Acres).

Table 3.5. Total Annual Groundwater Recharge for TID Distribution System and Service Area¹

Year	Year Type	Upper Main Canal Seepage (AF)	Turlock Lake Seepage (AF)	Canal Seepage (AF)	Deep Percolation of Applied Water (AF)	Deep Percolation of Precipitation (AF)	Total Recharge	
							(AF)	(AF/ac)
2020	Dry	13,100	22,100	46,000	111,700	35,100	228,000	1.2
2021	Dry	12,600	14,800	40,400	75,700	50,900	194,500	1.0
2022	Normal	12,800	11,000	41,600	99,400	54,400	219,100	1.1
2023	Normal	15,700	27,200	45,400	126,500	106,300	321,100	1.6
2024	Normal	15,300	36,100	47,500	155,000	94,500	348,400	1.8
2020-2024	Average	13,900	22,240	44,180	113,660	68,240	262,200	1.3
	Minimum	12,600	11,000	40,400	75,700	35,100	194,500	1.0
	Maximum	15,700	36,100	47,500	155,000	106,300	348,400	1.8
2014-2024	Average	13,000	23,500	42,300	105,400	72,200	256,400	1.3
	Normal Year Avg.	14,200	35,100	43,800	125,500	92,100	310,700	1.6
	Dry Year Avg.	11,900	13,800	41,000	88,700	55,700	211,100	1.1
	Average Percent	5%	9%	16%	41%	28%	100%	

¹ Volumes rounded to nearest 100 AF.

Between 2020 and 2024, total recharge within the Turlock Irrigation District (TID) service area and distribution system downstream of La Grange Dam was estimated to range from

¹⁰ The closure term is calculated as the difference between all other measured or estimated inflows and outflows from an accounting center – the unit of area over which the water balance is calculated.

approximately 194,500 acre-feet (AF) to 348,400 AF per year, equivalent to 1.0 to 1.89 AF per gross acre per year. On average, recharge was approximately 262,000 AF per year (1.3 AF/acre) for the 2020–2024 period and 256,400 AF per year (1.3 AF/acre) for the broader 2014–2024 period. Over the 2014–2024 period, recharge in normal years was nearly 100,000 AF greater on average, than in dry years.

The sources of recharge are distributed as follows: approximately 31 percent from canal and lateral seepage, 41 percent from deep percolation of applied water, and 28 percent from deep percolation of precipitation.

Groundwater remains an important supplemental supply within the TID service area, particularly in dry years when surface water deliveries are limited. In addition to TID’s reliance on groundwater, other users within the service area—including urban areas, industrial pumpers, private agricultural pumpers, and domestic pumpers—also depend on groundwater to varying degrees each year.

To enhance recharge opportunities, TID has participated in a ten-year pilot groundwater recharge project with the Eastside Water District (EWD) (see Section 7.4.8). Building on this effort, TID is implementing a replenishment water program and water accounting structure under which TID sells replenishment water to EWD at \$50/AF when supplies are available. Replenishment water is made available when TID growers receive a full allotment of surface water (48 inches). Recharge resulting from replenishment water is not included in the analysis above because it occurs outside of the TID service area; however, replenishment water deliveries are accounted for as an outflow in the TID water balance.

TID is also continuing to take an active leadership role in implementation of the Sustainable Groundwater Management Act of 2014 (SGMA), and development of the Groundwater Sustainability Plan (GSP) for the Turlock Subbasin. As discussed in **Section 4.1.2**, analyses have shown that seepage and deep percolation of a portion of TID’s surface water supply serves as the primary source of recharge to the groundwater system. Thus, while groundwater provides a significant portion of the water used by the District and others within the Turlock Subbasin, much of this groundwater is derived from management of surface water resources by TID and its irrigation customers. Because of the long-term supply reliability offered by access to both surface water and groundwater as sources of supply, TID will continue to pursue a deliberate course of conjunctive management. In addition to its own water management practices, TID will also continue to work with local interests to develop the tools needed to achieve long-term groundwater sustainability by identifying additional ways to maximize local water supplies, enhance conjunctive management practices, and recharge the groundwater system.

Table 3.6 summarizes net groundwater recharge within the TID service area, calculated by subtracting total groundwater pumping volumes from total recharge volumes. Pumping volumes include measured pumping from TID drainage wells and TID-rented wells, as well as private pumping volumes estimated from electrical energy use. Recharge volumes include both deep percolation and seepage, as shown in **Table 3.5**. Net recharge provides a measure of the overall effect of TID operations on groundwater storage conditions.

Table 3.6. TID Annual Net Groundwater Recharge by Calendar Year.¹

Year	Hydrologic Year Type	Total Recharge ³ (AF)	Groundwater Pumping (AF)	Net Recharge	
				(AF)	(AF/ac)
2020	Dry	228,000	146,100	81,900	0.4
2021	Dry	194,500	185,900	8,600	0.0
2022	Dry	219,100	227,700	-8,600	0.0
2023	Normal	321,100	72,000	249,100	1.3
2024	Normal	348,400	81,900	266,500	1.4
2020-2024	Average	262,220	142,720	119,500	0.6
	Minimum	194,500	72,000	-8,600	0.0
	Maximum	348,400	227,700	266,500	1.4
2014-2024	Average	256,400	137,200	119,200	0.6
	Normal Year Avg.	310,700	87,000	223,700	1.1
	Dry Year Avg.	211,100	179,100	32,000	0.2

¹ Volumes rounded to nearest 100 AF.

Between 2020 and 2024, net recharge ranged from a low of -8,600 AF (0.0 AF/acre) in 2022 to a high of 266,500 AF (1.4 AF/acre) in 2024. On average, net recharge was 119,500 AF per year (0.6 AF/acre) over the 2020–2024 period and 119,200 AF per year (0.6 AF/acre) over the broader 2014–2024 period.

Over the longer 2014–2024 period, average net recharge in normal years was more than 100,000 AF (0.8 AF/acre) greater than in dry years. Notably, the computed net recharge values represent only the area within the water balance boundaries.

3.6 TRANSFERS AND EXCHANGES

TID is implementing a Groundwater Accounting Structure Agreement with the East Turlock Subbasin Groundwater Sustainability Agency (ETS GSA). Under this Agreement, TID will provide the ETS GSA the opportunity to purchase up to 35,000 acre-feet per year (AFY) of replenishment water for irrigation purposes when 48 inches or more of surface water is made available to TID customers. TID does not guarantee a specific quantity of replenishment water, as availability is dependent on TID demand and prevailing hydrologic conditions. These sales help reduce reliance on groundwater pumping by providing both in-lieu and direct recharge benefits in the area of the cone of depression east of the TID service area.

No water is transferred into the TID service area from external sources.

During periods of surface water shortage, growers within the District may rely on internal water transfers to balance irrigation demands across their operations. Such transfers allow water unused on one parcel to be applied to another parcel, provided both parcels are owned by the same grower or held under long-term lease.

3.7 OTHER WATER USES

Other incidental water uses within the TID service area include road watering for dust abatement, agricultural spraying, and stock watering by TID customers. In addition, TID

SECTION THREE

Quantity of Water Uses

provides water for limited flood irrigation of church yards and school fields. The total volume of water used for these purposes is negligible compared to other agricultural and operational uses. While these volumes are included in the total reported delivery volumes, they have not been quantified separately.

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4. Quantity and Quality of Water Resources

This section of the AWMP describes the quantity and quality of the water resources available to TID.

As described at the beginning of **Section 3**, the following periods are used for the presentation and interpretation of water supply data:

1. **2020-2024 Period (Near-Term Historical):** The 2020-2024 data are reflective of recent TID operations and weather conditions.
2. **2014-2024 Period (Long-Term Historical):** The 2014-2024 data are reflective of longer-term historical TID operations and weather conditions.

4.1 WATER SUPPLY QUANTITY

Over the last five years, the total TID water supply has averaged approximately 656,100 acre-feet (AF) (**Table 4.1**). Water use patterns within the TID irrigation service area, as characterized through the water balance analysis—a central component of this Agricultural Water Management Plan (AWMP)—are further described in Section 5. Recycled water supplies generated and reused within the service area are presented in **Table 4.1**; however, these volumes are not included in the Total Supply because they represent internal reuse rather than new inflows to the water balance boundary.

Table 4.1. Summary of Water Supply Volumes within TID (Acre-Feet).¹

Year	Available Water (inches) ²	Year Type	Surface Water Supply ³		Groundwater Supply ⁴	Other Water Supply ⁵	Total Supply	Internal Recycled Supply ⁶
			Irrigation	Planned				
2020	42	Dry	466,800	0	146,700	8,200	621,700	8,500
2021	34	Dry	414,200	0	191,000	11,800	617,000	6,900
2022	27	Dry	373,000	1,200	238,800	8,500	621,500	5,800
2023	48	Normal	535,900	100,800	72,500	24,800	734,100	10,700
2024	48	Normal	546,400	45,000	82,300	12,800	686,500	9,900
2020-2024	Average		467,200	29,400	146,300	13,200	656,100	8,400
	Minimum		373,000	0	72,500	8,200	617,000	5,800
	Maximum		546,400	100,800	238,800	24,800	734,100	10,700
2014-2024	Average		474,200	14,900	143,600	15,700	648,300	8,800
	Normal Year Avg.		572,100	32,500	87,600	21,300	713,600	10,600
	Dry Year Avg.		392,500	200	190,300	10,900	594,000	7,400

¹ Calendar year volumes rounded to the nearest 100 AF.

² Depth of water in inches available equally to each acre of land.

³ Irrigation releases from La Grange Dam, and planned releases (non-irrigation purposes such as flood control from Don Pedro Reservoir).

⁴ Includes TID drainage pumping, TID rented pumping, and private pumping.

⁵ Includes measured drain pumping at TID Pump 152, treated Municipal and Industrial (M&I) effluent delivered to farms, and storm flow from upslope lands.

⁶ Includes measured tailwater and tilewater that flow back into TID canals.

TID practices conjunctive water management—the coordinated operation and monitoring of surface water and groundwater—to provide a firm, reliable supply to its service area. Crop water demands in TID vary little from year to year, allowing TID to meet this consistent demand by maximizing surface water use in normal years (which also recharges groundwater) and relying more on groundwater in dry years when surface water is limited (**Table 4.2**). Over the 2014–2024 period, surface water supplied an average of 73% of total demand, while groundwater contributed 22% on average. Groundwater’s role increases in dry years, supplying 32% of demand compared to 12% in normal years, highlighting the importance of conjunctive management in maintaining reliable water delivery under variable conditions.

In accordance with the Sustainable Groundwater Management Act of 2014 (SGMA), local agencies must work together to achieve sustainable groundwater use in the Turlock Subbasin by 2042. TID is a member of the West Turlock Subbasin Groundwater Sustainability Agency (WTSGSA), which worked with the East Turlock Subbasin Groundwater Sustainability Agency (ETSGSA) to develop the Groundwater Sustainability Plan (GSP) for the Turlock Subbasin. The GSP was submitted to the Department of Water Resources (DWR) in January 2022, and in January 2024, was determined by DWR to be incomplete. The GSAs addressed the deficiencies and corrective actions identified by DWR and submitted a Revised GSP in July 2024. The 2024 Revised GSP was approved by the DWR in February 2025.

The Turlock Subbasin depends on groundwater and surface water in both wet and dry years. During WY 2022, a dry year, groundwater was 62% of total water supply in the Turlock Subbasin (Todd Groundwater and Woodard & Curran, 2023), while in WY 2023, a wet year, groundwater was 47% of total water supply (Todd Groundwater and Woodard & Curran, 2024b). As shown on **Table 4.2**, due to the availability of surface water within TID, groundwater was 39% of total supply within TID in 2022 and 10% in 2023. The GSAs have committed to implementing projects and management actions to maintain a sustainable groundwater supply.

Table 4.2. Summary of Water Supplies within TID as a Percentage of Total Supply.¹

Year	Available Water (inches) ²	Year Type	Surface Water Supply ³		Groundwater Supply ⁴	Other Water Supply ⁵	Total Supply	Internal Recycled Supply ⁶
			Irrigation	Planned				
2020	42	Dry	75%	0%	24%	1%	100%	1%
2021	34	Dry	67%	0%	31%	2%	100%	1%
2022	27	Dry	60%	0%	39%	1%	100%	1%
2023	48	Normal	73%	14%	10%	3%	100%	1%
2024	48	Normal	80%	6%	12%	2%	100%	1%
2020-2024	Average		71%	5%	22%	2%	100%	1%
	Minimum		60%	0%	12%	1%	N/A	1%
	Maximum		74%	14%	33%	3%	N/A	1%
2014-2024	Average		73%	2%	22%	3%	100%	1%
	Normal Year Avg.		80%	5%	12%	3%	100%	1%
	Dry Year Avg.		66%	0%	32%	2%	100%	1%

¹ Calendar year volumes rounded to the nearest 100 AF.

² Depth of water in inches available equally to each acre of land.

³ Irrigation releases from La Grange Dam, and planned releases for non-irrigation purposes such as flood control releases from Don Pedro Reservoir.

⁴ Includes TID drainage pumping, TID rented pumping, and private pumping.

⁵ Includes measured drain pumping at TID Pump 152, treated Municipal and Industrial (M&I) effluent delivered to farms, and storm flow from upslope lands.

⁶ Includes measured tailwater and tilewater that flow back into TID canals.

The subsections below provide more detail describing water supplies in TID. The facilities referred to in this section are described in greater detail in **Section 2** of the AWWP, and are shown in the map provided in **Appendix D**.

4.1.1 Surface Water Supply

The Tuolumne River is the source of TID’s surface water supply. TID diverts water according to a series of pre- and post-1914 flow and storage water rights recognized by the State of California. TID's surface water supply is dependent on annual hydrologic and reservoir storage conditions. Irrigation water from Don Pedro Reservoir is diverted into the TID Upper Main Canal at La Grange Diversion Dam. Diversions flow via gravity through the Upper Main Canal to Turlock Lake for temporary storage and re-regulation for irrigation deliveries. Hydrology can vary widely, but this variability is somewhat mitigated by storage capacity at Don Pedro Reservoir. While the reservoir is large, TID’s share is only 68.46 percent of the available storage above the minimum operating pool.

Table 4.3 summarizes annual TID releases from La Grange Diversion Dam for irrigation and non-irrigation purposes (planned releases). Annual surface water supply volumes are provided along with the portion of total water supply derived from surface water. Planned releases, typically made for flood control, are not intended for irrigation deliveries. The table highlights that planned releases account for a small portion of total supply, averaging 2% over the long-term period, while irrigation deliveries provide most of the surface water, averaging 73%. In dry years, nearly all water released is used for irrigation, whereas in normal years a significant portion may be released for flood control and other non-irrigation purposes. This demonstrates

SECTION FOUR

QUANTITY AND QUALITY OF WATER RESOURCES

TID's ability to balance irrigation demands and operational objectives through careful management of both irrigation and planned surface water releases.

Table 4.3. Summary of Surface Water Supply Relative to Total Water Supply.¹

Year	Available Water (inches) ²	Year Type	Acre-Feet		Percent of Total Supply	
			Irrigation	Planned	Irrigation	Planned
2020	42	Dry	466,800	0	75%	0%
2021	34	Dry	414,200	0	67%	0%
2022	27	Dry	373,000	1,200	60%	0%
2023	48	Normal	535,900	100,800	73%	14%
2024	48	Normal	546,400	45,000	80%	6%
2020-2024	Average		467,200	29,400	71%	5%
	Minimum		373,000	0	60%	0%
	Maximum		546,400	100,800	74%	14%
2014-2024	Average		474,200	14,900	73%	2%
	Normal Year Avg.		572,100	32,500	80%	5%
	Dry Year Avg.		392,500	200	66%	0%

¹ Irrigation season values, rounded to nearest 100 AF.

² Depth of water in inches available equally to each acre of land.

³ Total water supplies are shown in Table 4.1.

Table 4.4 shows that surface water releases into the TID distribution system vary seasonally to match irrigation demand. Releases are generally lowest in winter months (December–February), increase steadily in spring, peak in July, and then gradually decline through fall. Dry years tend to have a higher proportion of releases during peak irrigation months (June–August) compared to normal years, reflecting the greater reliance on surface water for crop irrigation when overall water availability is limited. Conversely, normal years show relatively higher releases in spring and early fall, including planned releases, to accommodate flood control and operational requirements. This monthly distribution demonstrates TID's adaptive management of surface water to meet crop demands while balancing operational and regulatory objectives.

Table 4.4. Average Monthly Distribution of Diversions at La Grange Diversion Dam¹.

Period	Statistic	Percent of Total Annual Release ²											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2020-2024	Average	2%	2%	6%	10%	13%	16%	20%	15%	9%	7%	0%	1%
	Minimum	0%	0%	2%	8%	11%	14%	17%	13%	9%	5%	0%	1%
	Maximum	7%	4%	8%	12%	15%	17%	21%	17%	9%	10%	0%	3%
2014-2024	Average	1%	1%	4%	10%	13%	17%	20%	16%	9%	7%	0%	1%
	Normal Year Avg.	2%	3%	5%	9%	12%	16%	19%	15%	9%	10%	0%	0%
	Dry Year Avg.	0%	0%	4%	11%	13%	18%	22%	17%	9%	5%	0%	1%

¹ Includes both irrigation and planned releases

² Represents the minimum, maximum or average distribution for that month over the given timeframe. The total of the monthly percentages do not equal 100% in all cases nor were they intended to.

4.1.2 Groundwater Supply

The Turlock Subbasin (also referred to in this document as the Subbasin) underlies TID and is a subunit of the San Joaquin Valley Groundwater Basin. The Turlock Subbasin lies in the eastern region of Stanislaus and Merced counties and covers approximately 347,000 acres (542 mi²). The Subbasin is bounded by the Tuolumne River on the north, the Merced River on the south, the San Joaquin River on the west, and the Sierra Nevada foothills to the east (DWR, 2006).

Several water agencies overlie the Turlock Subbasin, including both agricultural and urban entities (**Figure 4.1**). Ballico-Cortez Water District and Eastside Water District are located to the east of TID and do not have surface water supplies. They were formed to represent growers and private domestic water users in their areas who rely entirely upon groundwater for their water supply. In fulfillment of SGMA requirements, two Groundwater Sustainability Agencies (GSAs) were formed to jointly manage the Turlock Subbasin. These GSAs are the West Turlock Subbasin GSA, of which TID is a member, and the East Turlock Subbasin GSA (**Figure 4.2**)

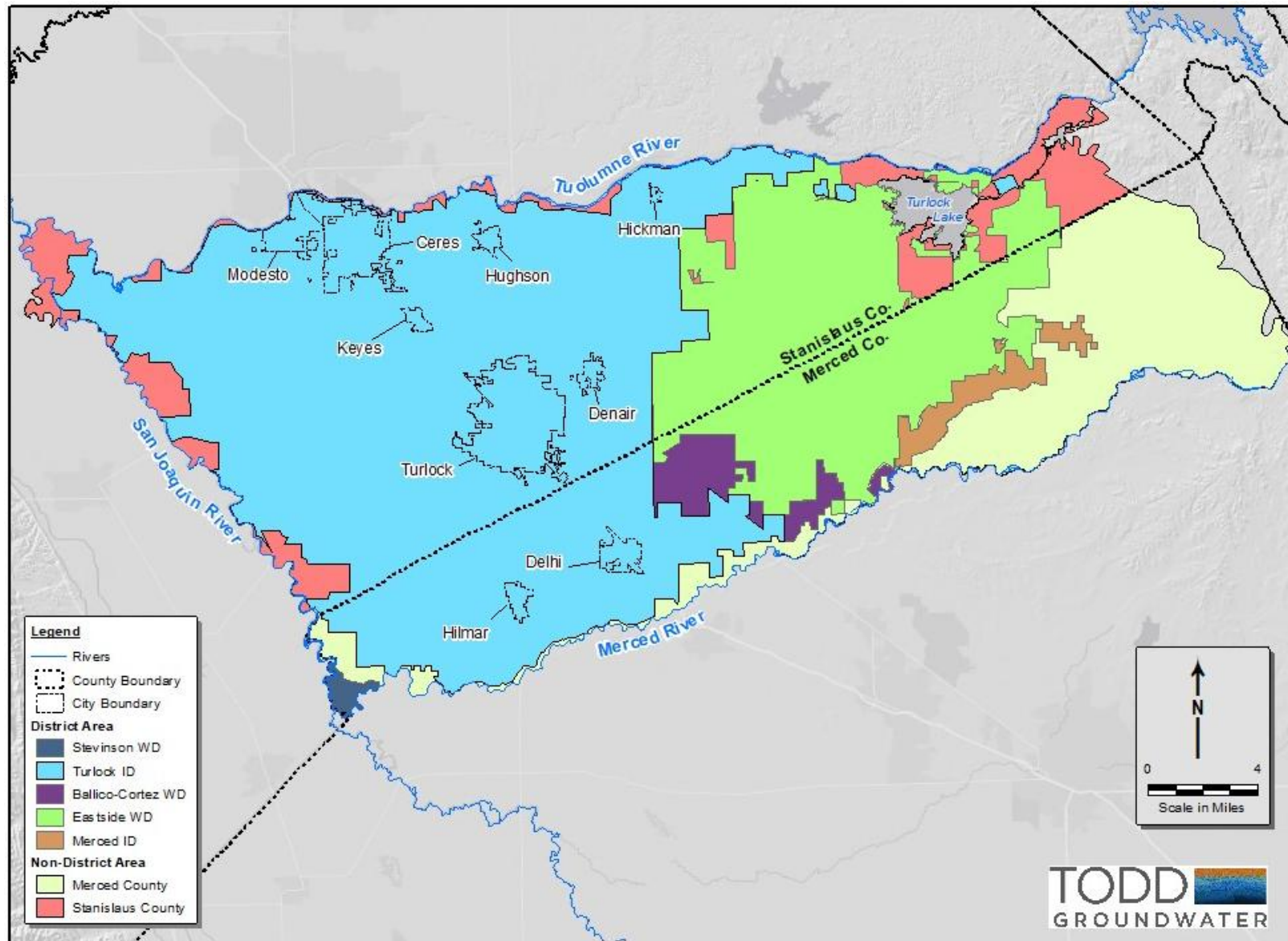


Figure 4.1. Jurisdictional Boundaries of Water Agencies (Todd Groundwater and Woodard & Curran, 2024a).

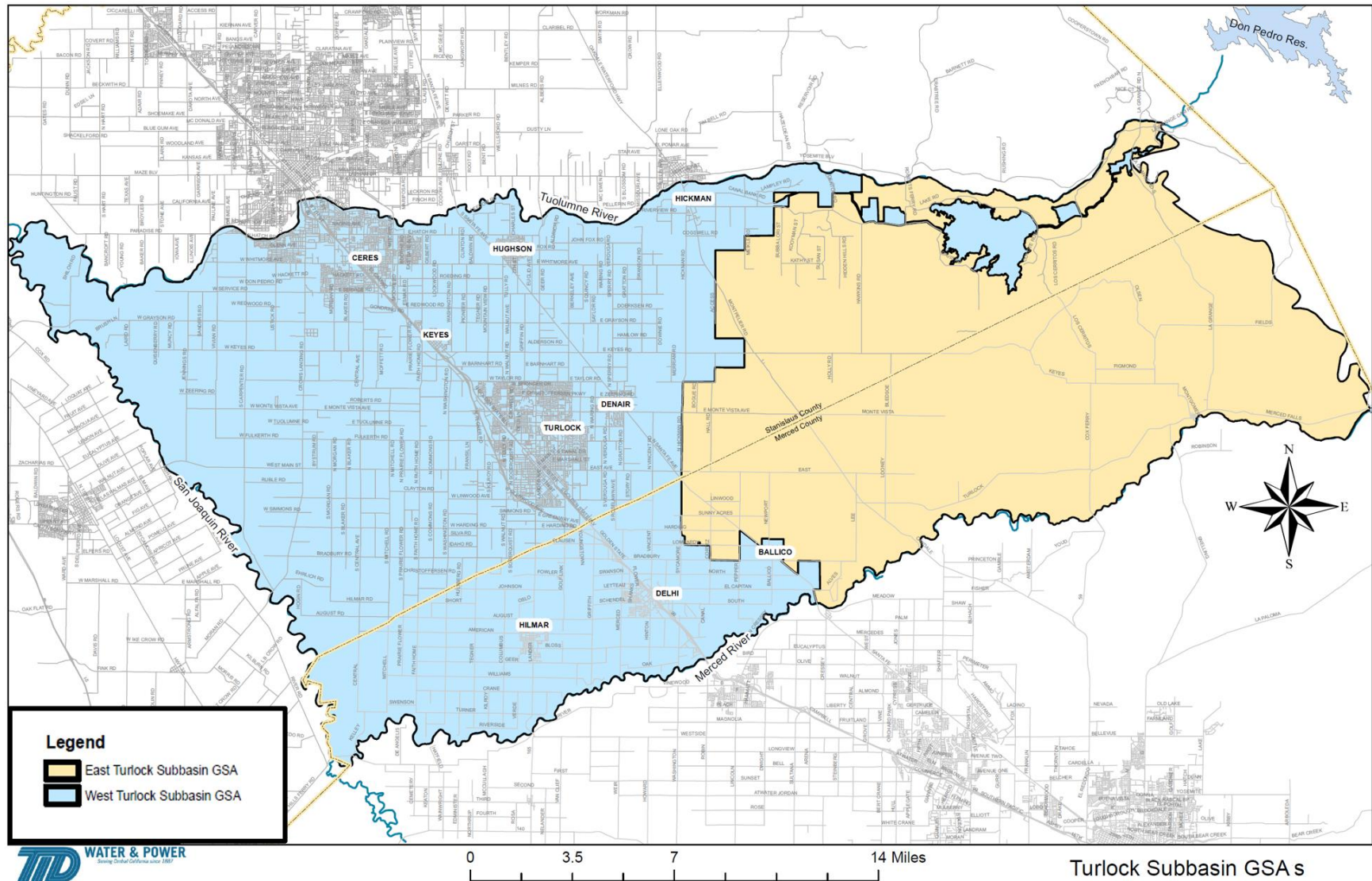


Figure 4.2. Turlock Subbasin and Groundwater Sustainability Agency Boundaries.

The GSP describes three principal aquifers within the Turlock Subbasin: the Western Upper Principal Aquifer, an unconfined aquifer in unconsolidated deposits above the Corcoran Clay on the western side of the Subbasin; the Western Lower Principal Aquifer, a confined aquifer below the Corcoran Clay on the western side of the Subbasin; and the Eastern Principal Aquifer, a semi-confined aquifer east of the Corcoran Clay. The depth and thickness of the Corcoran Clay varies across the western portion of the Subbasin. A cross section is provided as **Figure 4.3**.

The Western Upper Principal Aquifer is used for both agricultural and domestic supply. Relatively shallow (less than 150 feet deep) agricultural and domestic wells generally draw from the unconfined aquifer. The general direction of regional groundwater flow in the unconfined aquifer is naturally to the west-southwest towards the valley trough. However, private pumping for irrigated agriculture east of the TID has created a large cone of depression that intercepts the eastern edge of TID and induces some groundwater flow eastward, toward the pumping depression.

The Western Lower Principal Aquifer is a confined aquifer in the unconsolidated deposits beneath the Corcoran Clay. Accordingly, the areal extent of this confined aquifer is limited to the extent of the Corcoran Clay. Groundwater flow direction in the Western Lower Principal Aquifer is to the west-southwest. An analysis of vertical groundwater flow in the western Subbasin, within the footprint of the Corcoran Clay, shows that groundwater movement is downward from the unconfined aquifer through the Corcoran Clay to the confined aquifer (Todd Groundwater and Woodard and Curran, 2024a). This is consistent with USGS findings (Burow et al., 2004)

The Eastern Principal Aquifer includes the aquifer system east of the extent of the Corcoran Clay. It extends vertically from the shallow unconsolidated units (where present) through the deeper formations or to the base of fresh water. The Eastern Principal Aquifer becomes semi-confined with depth due to clay lenses and paleosols (Burow et al., 2004). Many wells in the Eastern Principal Aquifer are screened in the Mehrten Formation and overlying younger formations.

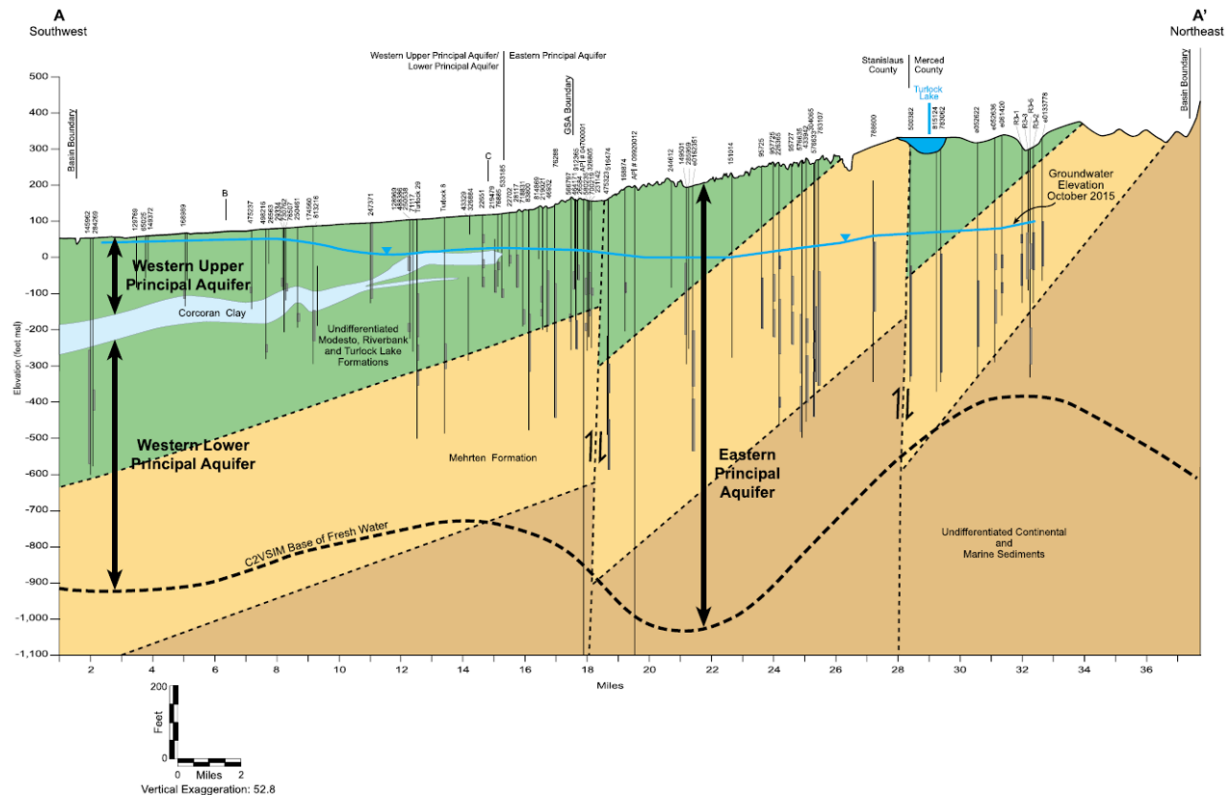


Figure 4.3. East West Cross Section Showing Principal Aquifers within the Turlock Subbasin (Todd Groundwater and Woodard & Curran, 2024)

The urban and private, rural domestic water systems within TID rely almost exclusively on groundwater for their source of water supply¹¹. Based on the GSP Annual Reports, extraction for urban and domestic water use in the Turlock Subbasin averaged 39,900 AF from WY 2016 to WY 2024. On average 32,000 AF was extracted by agencies and 7,900 AF was extracted by small water systems and domestic wells. The majority of municipal groundwater use in the Subbasin is drawn from the confined aquifer below the Corcoran Clay, while rural and small private residential groundwater is drawn from both the confined and unconfined aquifers. Urban groundwater use has decreased in recent years due to urban water conservation practices.

In late 2023, construction was completed on the Regional Surface Water Supply Project, led by the Stanislaus Regional Water Authority (SRWA). This project delivers treated Tuolumne River water in lieu of groundwater to the cities of Ceres and Turlock. The project delivered about 11,208 AFY of in lieu groundwater recharge in 2024. This resulted in decreased urban groundwater production during WY 2024.

Agricultural development east of TID began in the 1950s and is primarily reliant on groundwater for its water supply. In July 2024, a Groundwater Accounting Structure Agreement between WTSGSA and ETSGSA was approved. This agreement will reduce overdraft in ETSGSA, provide for the use and payment for decreasing amounts of transitional water to ETSGSA by

¹¹ TID and Modesto ID jointly provide surface water to the small community of La Grange located along the Tuolumne River, east of the TID service area. As the volume of water used is relatively small (30 AF/year, on average) and does not directly impact agricultural water management within TID, it is not described in detail herein.

TID, provide replenishment water to ETSGSA when available to offset groundwater use, and use revenue from the use of transitional water under the agreement towards groundwater sustainability projects. This Agreement will allow for efficient collaboration between WTSGSA, TID and ETSGSA to achieve Subbasin sustainability.

Groundwater supplies are an important component of TID’s conjunctive water management strategy and are used to supplement surface water deliveries, particularly during dry years. The volume of groundwater utilized on lands that receive surface water from TID is summarized in **Table 4.5**. Groundwater supply within TID is derived from several sources, including TID-owned drainage wells (TID drainage pumping), Improvement District or privately-owned wells that are rented by TID (TID rented pumping), privately-owned wells operated directly by landowners for irrigation (private pumping), and wells operated by landowners that pump into TID canals in exchange for surface water supply (Pump for Credit). In addition, groundwater pumping from three City of Ceres wells is included in TID’s groundwater accounting.

The pump for credit program allows landowners to pump groundwater into TID canals in exchange for an equal delivery of surface water from TID. This option enables growers to exchange a smaller capacity pumped volume for a larger capacity surface water delivery.

Groundwater pumping is greater in dry years, reflecting TID’s conjunctive management approach to managing surface water and groundwater supplies in order to maintain high water supply reliability. Prior to the 2012–2016 drought, private pumping volumes were comparatively small relative to total TID pumping and varied little between normal and dry years, illustrating the effectiveness of TID’s conjunctive management policies. However, the high volumes of private pumping observed in 2021–2022 indicate that, during extreme drought, groundwater storage and recharge resulting from TID’s conjunctive management policies provide critical support for landowner pumping when necessary.

It should be noted that estimates of private groundwater pumping are not based on direct measurements but rather are derived from power consumption data. Since TID’s first Agricultural Water Management Plan, estimates of private pumping have been refined on multiple occasions, most recently in 2014. These refinements have improved the accuracy of pumping estimates and reduced the potential for overestimation due to other electricity usage occurring on the same meter. TID will continue to review and revise the conversion factor in the future as needed.

Table 4.5 shows that groundwater supplies provided approximately 32% of total supply in dry years, compared to 12% in normal years over the long-term historical period (2014–2024). This pattern underscores the importance of groundwater as a supplemental supply during droughts and demonstrates the effectiveness of TID’s conjunctive management strategy.

Table 4.5. Summary of Groundwater Use for Irrigation within TID.¹

Year	Available Water (inches) ²	Year Type	Acre-Feet					Total Groundwater Supply	
			TID Drainage Pumping ³	TID Rented Pumping ³	Private Pumping ⁴	Pump For Credit ⁵	City of Ceres Pumping ⁶	Acre-Feet	Percent of Total Supplies within TID ⁷
2020	42	Dry	39,900	33,900	72,200	0	600	146,700	24%
2021	34	Dry	31,600	59,500	94,700	4,600	600	191,000	31%
2022	27	Dry	30,300	43,700	153,700	10,400	700	238,800	39%
2023	48	Normal	24,200	9,500	38,300	0	500	72,500	10%
2024	48	Normal	34,200	6,900	40,700	0	400	82,300	12%
2020-2024	Average		32,100	30,700	79,900	3,000	600	146,300	22%
	Minimum		24,200	6,900	38,300	0	400	72,500	12%
	Maximum		39,900	59,500	153,700	10,400	700	238,800	33%
2014-2024	Average		31,300	29,100	76,900	5,700	600	143,600	22%
	Normal Year Avg.		29,400	7,500	50,000	0	600	87,600	12%
	Dry Year Avg.		32,800	47,000	99,200	10,500	700	190,300	32%

¹ Irrigation season values only, rounded to nearest 100 AF. Volumes may differ slightly from other tables due to rounding.

² Depth of water in inches available equally to each acre of land.

³ TID pumping values are based on recent or annual pump tests and power consumption data.

⁴ Private pumping volumes estimated from power consumption data and private pumping survey.

⁵ In 2014-2015 and 2021-2022, TID allowed growers to pump groundwater into the canals and receive a delivery “credit” equal to the volume they supplied.

⁶ City of Ceres pumps is included in drainage pumping flow path in water balance.

⁷ Total water supplies are shown in Table 4.1.

4.1.2.1 Groundwater Conditions

Figure 4.4 shows groundwater elevation contours within the Turlock Subbasin in 1962, before the land east of TID was converted to irrigated agriculture. **Figure 4.5** shows groundwater elevations measured in 1989, after more than 25 years of groundwater extraction to the east of TID. Comparison of these figures illustrates the development of a pumping depression in the central/eastern region of the Turlock Subbasin caused by irrigation pumping.

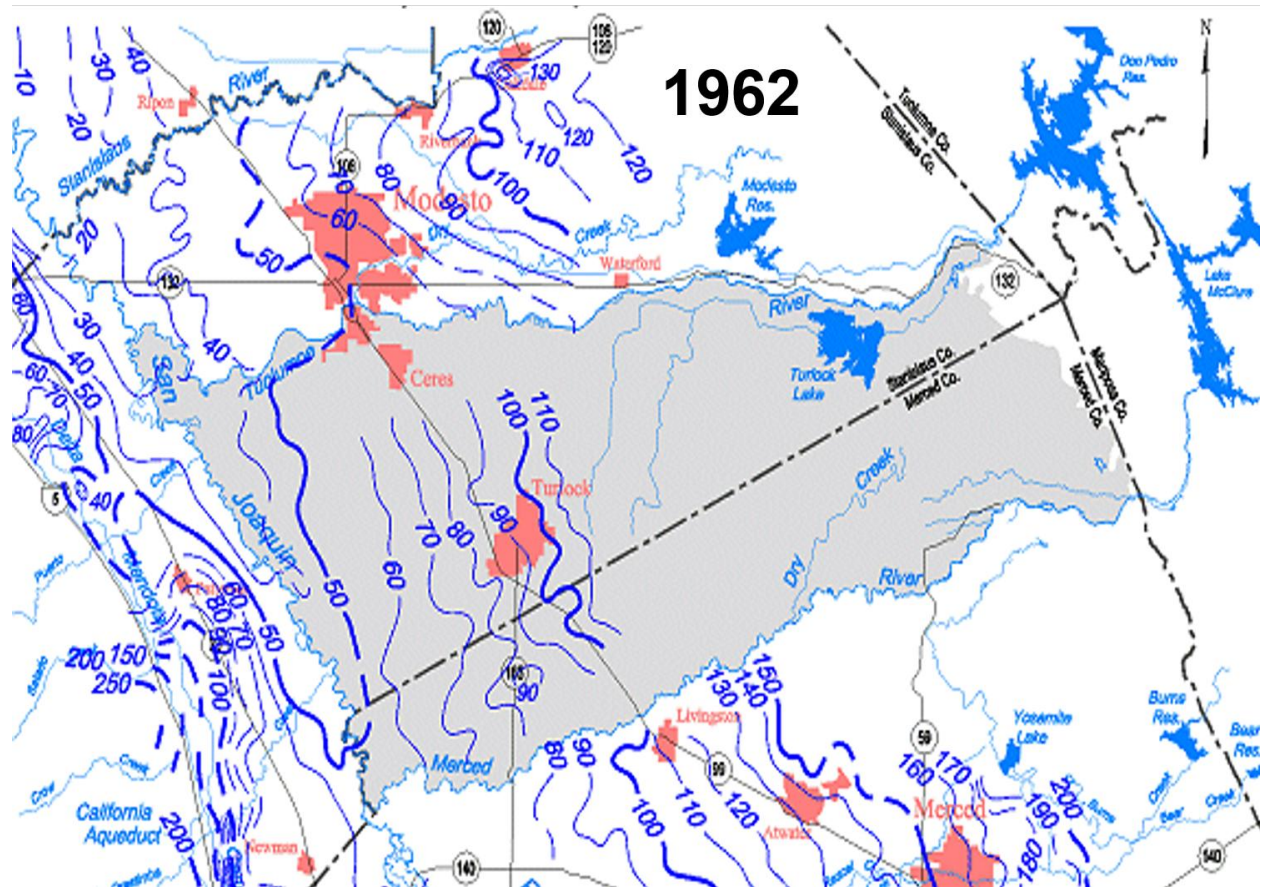


Figure 4.4. Groundwater Elevations – 1962 (DWR, n.d.).

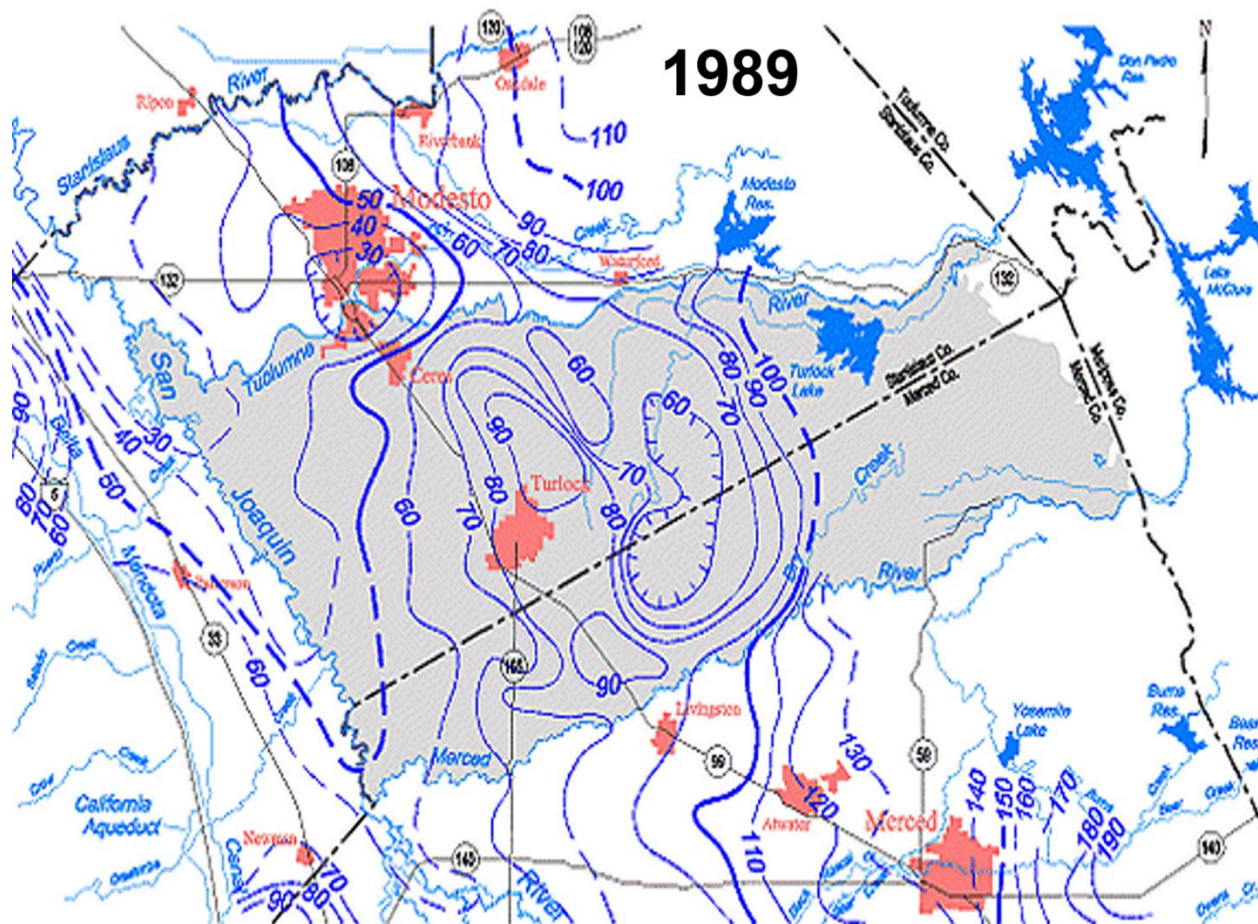


Figure 4.5. Groundwater Elevations – 1989 (DWR, n.d.).

Figures 4.6 and 4.7 show Fall 2015 and Fall 2023 groundwater elevation contours in the Western Upper and the Eastern Principal Aquifers. These figures show that the cone of depression has expanded over time, coinciding with expanding land development to the east of TID. Fall 2023 groundwater elevation contours show that regional groundwater flow within TID is generally to the west-northwest. A relatively broad mound, or area with higher groundwater levels, is located between Hilmar and Delhi, extending north to the southern edge of Turlock. Groundwater flow is generally away from the high point of the mound in all directions. In the northwestern part of the Subbasin, groundwater flows to the northwest in the vicinity of Ceres and Modesto and toward the downgradient extent of the Subbasin. Groundwater flow in the eastern region of TID is to the east, towards the pumping depression.

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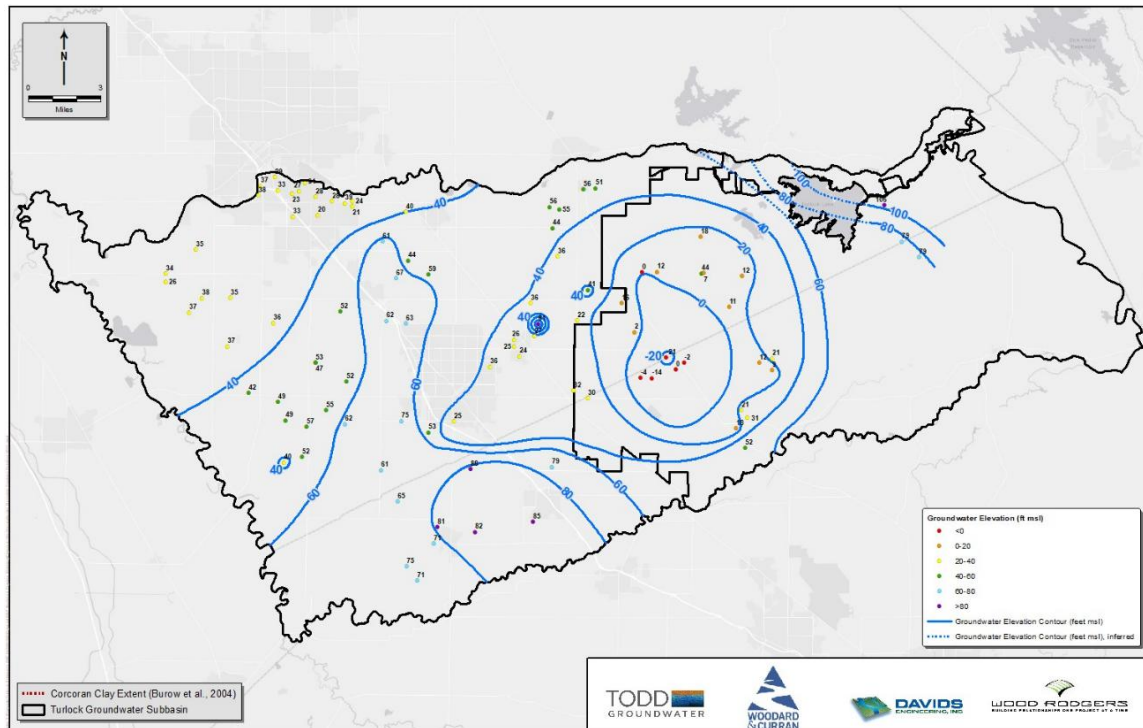


Figure 4.6. Groundwater Elevations – Fall 2015 (Todd Groundwater and Woodard & Curran, 2024a).

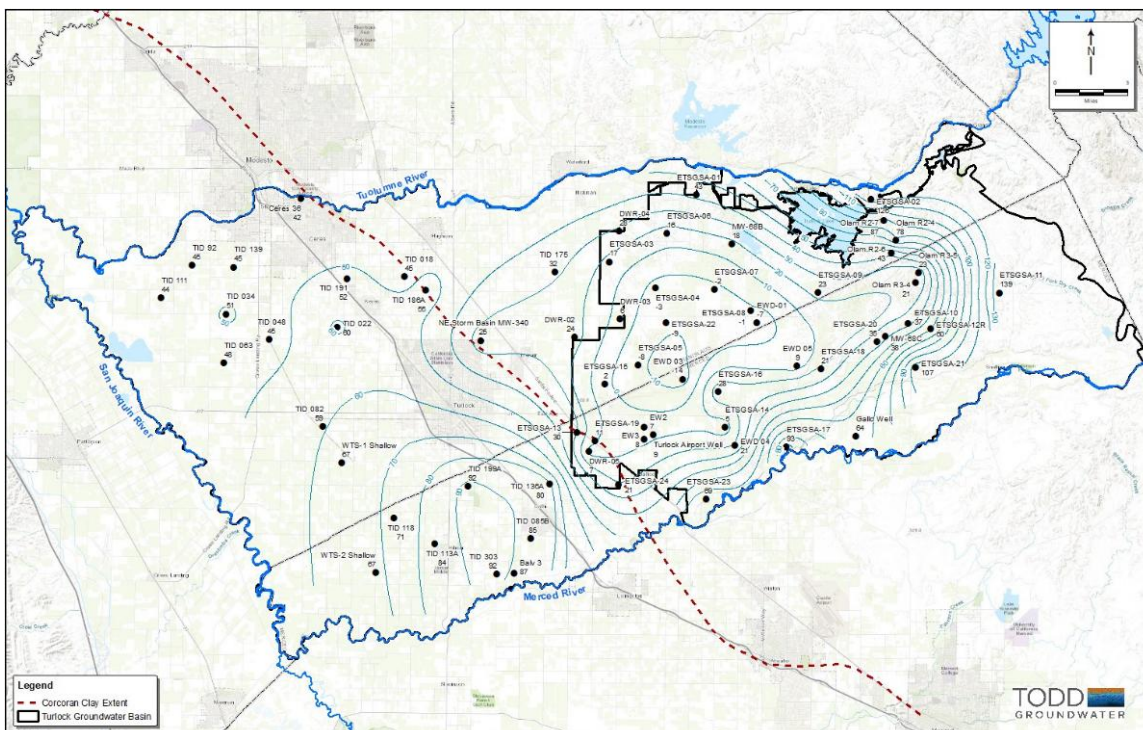


Figure 4.7. Groundwater Elevations – Fall 2023 (Todd Groundwater and Woodard & Curran, 2025).

TID adopted the Turlock Subbasin Groundwater Management Plan on March 18, 2008, representing the lands in its service area that are outside of the boundaries of the local municipalities (**Appendix B**). Following the 2008 update of the Groundwater Management Plan by TID and other local public agencies, management efforts focused on continued monitoring and evaluation of groundwater conditions.

In 2012, the TGBA was awarded a Local Groundwater Assistance grant by DWR to compile existing available data and evaluate groundwater conditions on the eastern side of the Turlock Subbasin. The project was conducted to provide an updated understanding of the geology and groundwater conditions on the eastern side of the Subbasin, which is dependent primarily on groundwater for its supply and where limited information has been available historically. The grant work was completed in March 2016 and is documented in the report “Final Report – Hydrogeological Characterization of the Eastern Turlock Subbasin” (**Appendix B**).

The Sustainable Groundwater Management Act (SGMA), passed in 2014, requires local agencies in the Turlock Subbasin to collaboratively achieve groundwater sustainability by 2042. Two GSAs, WTSGSA and ETSGSA, were formed to jointly manage the Turlock Subbasin and develop a Groundwater Sustainability Plan (GSP). The GSP was adopted and submitted to DWR in January 2022. In 2024, DWR issued an “incomplete” determination to the GSAs. The GSAs addressed the deficiencies and corrective actions identified by DWR and submitted a Revised GSP in July 2024. The Revised GSP was approved by DWR in February 2025.

Since GSP submittal in January 2022, GSP Annual Reports have been developed for water years 2021 through 2024, and annual reporting will continue during the GSP implementation period (until 2042). The Annual Reports provide an update on groundwater conditions in the Subbasin and document the progress towards sustainability. Planning and implementation of the projects and management actions provided in the GSP is underway. The projects include urban, municipal, and agricultural water supply projects within WTSGSA and agricultural water supply projects within ETSGSA. Many of the projects emphasize in-lieu or direct groundwater recharge. Management actions include demand reduction strategies, pumping management, and domestic well mitigation. The status of these projects and management actions are reported in each Annual Report.

TID is a member agency of WTSGSA. The goals and efforts of the AWMP and SGMA implementation are closely aligned. The monitoring and reporting conducted by the GSAs will provide valuable information to support agricultural water management planning efforts.

4.1.2.2 Conjunctive Management and Recharge

TID’s conjunctive management program is designed to encourage irrigators to use surface water supplies during periods of normal and above normal surface water availability. Surface water from the Tuolumne River, applied within the TID service area via flood irrigation, is the primary source of groundwater recharge within the Subbasin. Use of surface water during normal and wetter years recharges the aquifer, enabling TID to rely more heavily on groundwater during years when surface supplies are below normal. During dry years TID increases the volume of groundwater pumped into the distribution system from rented and drainage wells to supplement surface water supplies. **Table 4.5** shows that, on average, TID pumped approximately 43,000

more acre-feet of groundwater through rented wells and drainage pumping in dry years than in normal years between 2014 and 2024.

Sustained use of surface water for irrigation is a key component of TID's conjunctive management of surface water and groundwater supplies. The TID water balance indicates that over the period from 2014 to 2024 total net groundwater recharge within the TID service area ranged from an average of 0.2 AF per acre during dry years to an average of 1.7 AF per acre during normal years. **Table 4.6** provides a summary of net recharge within TID, including the contributions of deep percolation and seepage from canals. These results show the importance of continuing irrigation with surface water to maintain groundwater recharge for storage of water supplies that can be used in drier years. TID's tiered volumetric pricing structure for surface water (described in **Section 2.2.3**) is designed to encourage growers to use available surface water supplies to provide appropriate in-lieu and direct groundwater recharge. Having two rate schedules, one for normal or wetter years and one for dry years, encourages different water use practices between normal and dry water year types. In normal and wetter years, lower pricing of surface water encourages growers to use available surface water supplies. In dry years, the pricing encourages conservation of limited surface water supplies and provides additional revenue to recover increased pumping costs. However, even in dry years, surface water is priced affordably compared to private groundwater pumping. An important aspect of TID's conjunctive management strategy includes setting the price of TID water appropriately to discourage growers from becoming permanently reliant on groundwater.

TID's conjunctive management program is designed to encourage irrigators to use surface water supplies during periods of normal and above-normal surface water availability. Surface water from the Tuolumne River, applied within the TID service area via flood irrigation, is the primary source of groundwater recharge within the Subbasin. Use of surface water during normal and wetter years recharges the aquifer, enabling TID to rely more heavily on groundwater during years when surface supplies are below normal. During dry years, TID increases the volume of groundwater pumped into the distribution system from rented and drainage wells to supplement surface water supplies. **Table 4.5** shows on average, between 2014 and 2024, TID pumped approximately 43,000 more acre-feet of groundwater through rented wells and drainage pumping in dry years than in normal years.

Sustained use of surface water for irrigation is a key component of TID's conjunctive management of surface water and groundwater supplies. The TID water balance indicates that, over this period, total net groundwater recharge within the TID service area ranged from an average of 0.2 acre-feet per acre during dry years to 1.7 acre-feet per acre during normal years (**Table 4.6**). Net recharge includes contributions from deep percolation of applied water and precipitation, as well as seepage from canals, and underscores the importance of continuing surface water irrigation to maintain groundwater storage for use in drier years. TID's tiered volumetric pricing structure for surface water (described in **Section 2.2.3**) encourages growers to utilize available surface water supplies in normal and wetter years while promoting conservation in dry years, ensuring that growers are not permanently reliant on groundwater.

The Water Sales Agreement between TID and the Stanislaus Regional Water Authority (SRWA), executed in 2015 and amended in 2020, established a long-term surface water supply of up to 30,000 acre-feet annually from the Tuolumne River for municipal use. Deliveries began

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in 2023 following completion of the regional water treatment plant. By providing a reliable surface water supply during normal and wet years, the project reduces municipal reliance on groundwater pumping, creates opportunities for in-lieu recharge of the Turlock Subbasin, and strengthens regional drought resilience.

Table 4.6. Summary of TID Net Recharge downstream of Turlock Lake.¹

Year	Available Water (inches) ²	Year Type	Seepage (AF) ³	Deep Percolation (AF) ⁴	Groundwater Pumping (AF) ⁵	Net Recharge (AF) ⁶	Net Recharge ⁷ (AF/acre)
2020	42	Dry	81,200	146,800	146,700	81,400	0.6
2021	34	Dry	67,800	126,600	191,000	3,400	0.0
2022	27	Dry	65,300	153,800	238,800	-19,700	-0.2
2023	48	Normal	88,400	232,800	72,500	248,600	1.9
2024	48	Normal	98,900	249,500	82,300	266,100	2.0
2020-2024	Average		80,300	80,300	181,900	146,300	116,000
	Minimum		65,300	65,300	126,600	72,500	-19,700
	Maximum		98,900	98,900	249,500	238,800	266,100
2014-2024	Average		78,700	78,700	177,700	143,600	112,800
	Normal Year Avg.		93,100	93,100	217,500	87,600	223,100
	Dry Year Avg.		66,700	66,700	144,400	190,300	20,800

¹ Volumes do not include recharge in Turlock Lake or upstream of Turlock Lake.

² Depth of water in inches available equally to each acre of land.

³ Seepage from Upper Main Canal, Turlock Lake and TID's Distribution System below Turlock Lake

⁴ Deep percolation from lands that receive surface water within TID. Includes both deep percolation of applied water and deep percolation of precipitation.

⁵ Total from Table 4.5

⁶ Volume of net recharge is calculated as the sum of deep percolation and seepage minus total groundwater pumping.

⁷ Volume of net recharge is calculated as the sum of deep percolation and seepage minus total groundwater pumping divided by the irrigated area of lands that receive surface water within TID.

Complementing these efforts, TID and the City of Turlock entered into a Memorandum of Understanding (MOU) in 2023 to utilize the Dianne Storm Basin for groundwater recharge. The MOU allows recharge activities to continue in future years when replenishment water is available. In 2024, 640 acre-feet of replenishment water were delivered to the basin, further supporting conjunctive management.

TID also implements multiple recharge programs to optimize conjunctive use throughout its service area.

The On-Farm Recharge Project provides replenishment water to growers using winter Flood-MAR and winter in-lieu water when available. The project, approved for continuation by the TID Board, is regularly evaluated using GRAT to identify program opportunities. In 2024, 306 acre-feet of replenishment water were delivered through this program, with an additional 181 acre-

feet provided via the Idle Lands Project. The Idle Lands Project encourages growers with existing connections to TID canals to flood irrigate their land when not in production (idle land). Water used for this project can either be the Tuolumne River pre-flood releases or local winter runoff that enters the TID canal system.

The Agricultural Recharge Project promotes in-lieu recharge by selling replenishment water to growers in the ETS GSA when available. Infrastructure upgrades have connected over 2,500 acres in EWD and BCWD to sidegates on the Highline and Main Canals, facilitating increased deliveries from 3,938 acre-feet in 2023 to 5,887 acre-feet in 2024. TID worked with EWD to adopt design standards for new sidegates and assisted growers in planning installations. The ETS GSA also collaborated with TID on a conceptual pipeline project designed to deliver 20,000 acre-feet of replenishment water to growers in the area of the cone of depression and into the Sand Creek and Mustang Creek drainages. The pipeline, planned for a capacity of 50 cfs, will also deliver flood water from the Tuolumne River for direct recharge, with ongoing funding of \$200,000 per year to support its continuation and expansion.

Additional components of TID's conjunctive management strategy include regulating reservoirs at Lateral 5 1/2 and Lower Lateral 3 to optimize recharge timing and storage. Construction of the Lateral 5 1/2 reservoir is planned for March 2026. The Lower Lateral 3 reservoir is included in the Capital Improvement Plan and is scheduled for 2035.

TID also coordinates with private property owners who have installed micro-spray or drip irrigation on parcels with existing sidegates to receive replenishment water when available. In 2024, 225 acre-feet of recharge water were applied to these basins. Collectively, these programs demonstrate TID's strategic approach to conjunctive management, integrating surface water deliveries, infrastructure improvements, and on-farm recharge projects to optimize groundwater replenishment, support agricultural water demands, and maintain long-term subbasin sustainability.

The TID water balance, described in **Section 5**, shows the annual volumes of each water source used in TID. During the period from 2014 to 2024, surface water from the Tuolumne River supplied, on average, 75 percent of the water used by lands that received deliveries from TID. Groundwater supplied 22 percent of average annual demand, while the remaining 3 percent came from other sources (**Table 4.2**). In normal and wetter years, when more surface water was available, these average percentages shifted to 85 percent surface water, 12 percent groundwater, and 3 percent other supplies. In dry years, the average percentages were 66 percent surface water, 32 percent groundwater, and 2 percent other supplies.

In 2022, a historically dry year and the third dry year in a row, the percentage of water supplied by pumping was even greater (39 percent). TID pumped even more in past dry cycles (1976-1977) and (1987-1988). It should be noted that the high rates of groundwater extraction in 1977 (67 percent) and 1988 (56 percent) can no longer be achieved because of the decline in groundwater levels, particularly along TID's eastern boundary.

TID developed a drought conjunctive management plan in response to the increased groundwater use during the 1976-1977 and the 1987-1992 droughts. One outcome of the plan has been improved management of groundwater pumping throughout TID. Despite TID's efforts to

improve water resources management within the District, the ability to sustain groundwater supplies beneath the TID service area is hindered by substantial irrigation pumping east of TID. Irrigators outside TID, in the eastern portion of the Turlock Subbasin, have limited surface water supply. The substantial pumping required for irrigation outside TID, along with the small area of groundwater-only irrigation within TID, continues to contribute to the decline in water levels of the aquifers underlying TID, particularly during periods of drought. More efficient irrigation techniques being used in the groundwater-irrigated areas has helped lessen the impact of agricultural expansion on groundwater levels.

As described earlier, construction was completed, in late 2023, for the Stanislaus Regional Water Authority’s Regional Surface Water Supply Project. By delivering treated Tuolumne River water in lieu of groundwater use for the cities of Ceres and Turlock, this project provides groundwater recharge. Treatment plan capacity is 15 MGD, with monthly surface water deliveries during 2024 averaging 10 MGD.

4.1.3 Other Water Supplies

TID cooperates with local municipalities, industries and agriculture water uses to safely utilize recycled water. Categories of recycled water identified within TID are spillage recovery, recycled treated wastewater and storm flows from upslope watersheds (**Table 4.7**).

Table 4.7. Summary of TID Other Water Supplies¹.

Year	Available Water (inches) ²	Year Type	Other Supplies (AF)				Internal Recycling (AF)		
			Storm Flows ³	Spill Recovery ⁴	Treated Wastewater Delivered to Farms ⁵	Total Other Supplies	Tilewater to Canals	Tailwater to Canals	Total Internal Recycled Supply ⁶
2020	42	Dry	900	2,100	5,100	8,200	7,500	1,100	8,500
2021	34	Dry	5,400	1,700	4,700	11,800	5,900	1,000	6,900
2022	27	Dry	3,000	1,300	4,300	8,500	4,900	900	5,800
2023	48	Normal	18,400	1,900	4,400	24,800	9,700	1,000	10,700
2024	48	Normal	5,700	2,200	4,900	12,800	8,700	1,200	9,900
2020-2024	Average		6,700	1,900	4,700	13,200	7,300	1,000	8,400
	Minimum		900	1,300	4,300	8,200	4,900	900	5,800
	Maximum		18,400	2,200	5,100	24,800	9,700	1,200	10,900
2014-2024	Average		8,600	1,600	5,500	15,700	7,800	1,100	8,800
	Normal Year Avg.		14,700	1,800	4,800	21,300	9,300	1,300	10,600
	Dry Year Avg.		3,400	1,500	6,000	10,900	6,400	900	7,400

¹ Irrigation season values only, rounded to 100 AF.

² Depth of water in inches available equally to each acre of land. Prior to 2013, this was the allotment.

³ Water from upslope watershed, estimated based on watershed model HFAM and off-season water balance closure.

⁴ Volumes derived from measured flow at pump 152.

⁵ City of Modesto, Hilmar Cheese, City of Turlock reported annual volumes prorated based on days in the irrigation season

⁶ Includes measured tailwater and tilewater that flow back into TID canals.

Additionally, some long Improvement District pipelines were designed and constructed so they terminate at a TID canal in order to recover undelivered irrigation water where it can be used for irrigation delivery downstream. This undelivered water originates from fill-up and run-down

water, or, rarely, when growers choose to not take a delivery. The volume of water that is recovered in this manner has not been quantified independently due to its intermittent nature and is not currently included in the water balance.

The Harding Drain is a multi-use facility that has been used to transport treated effluent from the City of Turlock (until the end of 2014), urban runoff, drainage from lands adjacent to the drain, groundwater accretions, and canal spillage; however, the percentages of each are unknown. Historically, TID utilized water from the Harding Drain to supplement supplies in Lateral 5½. However, water reuse regulations restricted TID’s ability to recapture those flows for a period of time until the City of Turlock implemented tertiary treatment. TID was able to resume the reuse from the Harding Drain in July 2008. For the period from 2020 to 2024, an average of 1,900 AF of water per year was reused. This water is referred to as spill recovery in **Table 4.7**.

Another component of recycled water use is the application of recycled treated wastewater from the City of Modesto and City of Turlock. Dairy nutrient water and industrial process water from Hilmar Cheese are also used to irrigate lands within TID. Over the period of 2014 through 2024, an average of approximately 3,500 AF per year of recycled water from these sources has been used to irrigate approximately 2,000 acres of crops within the TID boundaries. Over the period 2020 to 2024, the average volume of recycled treated wastewater used for irrigation was approximately 2,600 AF per year. This water is included in the treated wastewater delivered to farms component of **Table 4.7**.

TID also assists growers who wish to receive nutrient water by allowing dairies to transport nutrient water through improvement district conveyance facilities. This recycling of dairy runoff reduces discharge, enables growers to utilize the nutrient water as fertilizer for forage crops, and provides water for irrigation. This component is difficult to estimate independently and is not currently included in the water balance.

Similarly, TID supports the practice of reusing industrial process water from Hilmar Cheese Company by allowing Hilmar Cheese to transport the process water through improvement district conveyance facilities. Using the existing improvement district facilities in this manner enables Hilmar Cheese to apply the process water for agricultural use, and allows the growers on those facilities to benefit from the water supply year-round, including the non-irrigation season when TID supplied irrigation water isn’t available. This type of reuse has increased over time as the Hilmar Cheese facility has diversified and expanded. Approximately 2,000 AF of process water is recycled per year, on average, and is included in the treated wastewater delivered to farms component of **Table 4.7**.

At the end of 2014, the City of Turlock redirected its wastewater discharges from the Harding Drain to the San Joaquin River. Beginning in 2015, spill recovery data for water pumped from the Harding Drain no longer included tertiary treated wastewater as a supply source, although Turlock Irrigation District (TID) continues to recover spill water and other flows in the drain for reuse.

To help offset surface water supplies dedicated to municipal use through the SRWA Regional Surface Water Supply Project, the City of Turlock has agreed to provide TID with tertiary treated wastewater for agricultural reuse. The Regional Water Quality Control Board (RWQCB) plans to authorize this use through Turlock’s wastewater NPDES permit. TID has identified the planned

Lateral 5.5 Regulating Reservoir as the facility that will receive, blend, and convey recycled water with surface water for delivery to nearby agricultural lands.

TID and City staff have collaborated to provide the RWQCB with the necessary data and technical analyses, with permit approval anticipated in January 2026 as part of the NPDES permit renewal. To implement the project, TID sought and was awarded grant funding through the U.S. Bureau of Reclamation’s WaterSMART program to help offset construction costs for the Lateral 5.5 Regulating Reservoir. Construction of the facility is planned to begin by September 2026, with completion targeted for March 2027 in advance of the start of the irrigation season.

Tailwater and tilewater are included in the internal recycling column because they represent reuse that is internal to the water balance. Internal recycling refers to water that is captured, returned, and reused within the TID distribution system before leaving the service area. Rather than being a new or external supply, this water is generated from irrigation activities, such as subsurface drainage (tilewater) or surface runoff (tailwater), that reenters the canals or drains and is blended with other canal water for subsequent delivery. Because the water remains within the district boundaries and is reused multiple times before ultimately exiting the system, it is considered “internal” to the water balance. This distinction is important because internal recycling does not increase the overall supply available to the district but instead improves the efficiency of use by maximizing beneficial reuse of water already in circulation.

Beginning in the 1990s, growers installed subsurface drainage systems (tile drains) to help control shallow groundwater. These drains discharge into TID canals, where the water is blended with canal supplies and reused to the greatest extent possible. Based on discharge measurements, these subsurface drainage systems contributed an average of 7,300 AF of tilewater per year to TID canals during 2020–2024.

Some tailwater also enters TID canals indirectly through drainage channels intercepted by the distribution system. This recovered tailwater is similarly blended with canal supplies and reused to the greatest extent possible. Based on water deliveries to parcels identified as contributing tailwater flows to intercepted drains, an average of approximately 1,000 AF of tailwater entered the TID distribution system annually during 2020–2024.

4.2 WATER SUPPLY QUALITY AND MONITORING PRACTICES

TID actively monitors the water quality of canals and wells through samples collected under several different water quality programs. Some of these programs are voluntary and self-directed, such as the agricultural suitability (Ag Suitability) monitoring program. Others are required regulatory programs, such as TID’s monitoring under the Statewide General National Pollutant Discharge Elimination System (NPDES) Permit for Residual Aquatic Pesticide Discharges (Aquatic Pesticide Permit). Sample water quality data are summarized in **Table 4.8**, showing the average and range of values for the various constituents monitored at sites throughout the District in recent years.

4.2.1 Surface Water Supply and Agricultural Suitability Monitoring

Agricultural suitability (Ag Suitability) monitoring is regularly performed at Turlock Lake and all spill locations to monitor long-term water quality trends in the TID system. Samples collected at Turlock Lake are representative of source water quality. As described in **Section 2**, surface water supply in TID originates from Don Pedro Reservoir, and is initially stored in Turlock Lake before it is delivered to irrigation customers. Samples collected at spillage locations are not representative of source water quality; however, because they are at the bottom end of the canal system, they do represent a possible worst case scenario of water quality of waters delivered to growers. The Ag Suitability water quality data is provided to growers upon request. The agricultural suitability monitoring conducted approximately twice each season includes analysis for a standard “ag panel”: sodium, calcium, magnesium, carbonate, bicarbonate, chloride, phosphorus, potassium, nitrate, sulfate, boron, total dissolved solids (TDS), pH, electrical conductivity (EC), and adjusted sodium adsorption ratio (adj. SAR).

4.2.2 Groundwater Supply Monitoring

TID has monitored the water quality of most TID-owned drainage wells plus the rented wells used for irrigation supply. Groundwater samples have historically been analyzed for the same “ag panel” listed above. Data gathered over the years shows that water quality does vary between wells, but not significantly from year to year. As funds allow, drainage wells and rented wells are sampled to maintain a good understanding of the quality of groundwater entering the canal system. Additionally, if there are concerns regarding water quality in a specific area or from a particular well, samples are collected to confirm the current water quality conditions. Testing of TID drainage wells and rented wells has not occurred regularly in recent years on account of staffing constraints during recent drought periods and expansion of automation across the TID system. **Table 4.9** shows the average and range of values for the various constituents monitored at sites throughout the District in historical years.

During droughts, one of the objectives of TID’s conjunctive management program is to provide a water supply that satisfies irrigation demands in terms of quantity, timing of deliveries, and water quality. To this end, the process for selecting wells that are used to supplement surface water supplies includes consideration of well salinity levels. WDOs are provided well salinity levels and utilize that information to provide the growers with the best water quality possible, including minimizing the use of wells with elevated salinity levels when it could affect germination of crops.

Samples collected from TID-owned drainage wells and rented wells show that some wells provide water with elevated TDS levels. A few wells provide water with TDS levels that exceed 2,000 parts per million (ppm). Across all measurements made by TID, the average groundwater TDS is 738 ppm. The pumped groundwater is mixed with surface water in the distribution system, resulting in irrigation water of acceptable quality. Groundwater salinity generally increases from east to west across TID and with well depth.

As a member of WTSGSA, TID participates actively in GSP development and implementation. The 2024 Revised GSP (Todd Groundwater and Woodard & Curran, 2024b) provides extensive discussion of groundwater quality across the Subbasin, including distribution maps for TDS and other constituents.

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TID also collects an “ag panel” groundwater sample during the formation of a pump Improvement District. As a general policy, if the EC of the new well is above 1.5 dS/m (or about 1,000 ppm TDS), TID staff recommends that the Improvement District not be formed.

Table 4.8. Summary of TID Water Quality Monitoring Results for 2020-2024.

Source	Constituent ¹	Average	Range	Units ²
Spill Locations	Sodium	1.8	0.05-6.0	meq/L
	Calcium	1.6	0.00-4.3	meq/L
	Magnesium	0.8	0.09-2.1	meq/L
	Bicarbonate	1.9	0.03-5.3	meq/L
	Chloride	1.1	0.00-6.2	meq/L
	EC	0.5	0.03-1.2	dS/m
	pH	7.9	6.10-8.8	standard units
	Phosphorus	0.2	0.00-.9	ppm
	Potassium	2.9	0.04-14.3	ppm
	Nitrate	22.7	0.00-105.0	ppm
	Sulfate	17.7	1.00-59.0	ppm
	Boron	0.0	0.00-.2	ppm
	TDS	305.1	14.00-839.0	ppm
	adj SAR	1.8	0.05-6.4	-
Source (Turlock Lake Outlet)	Sodium	0.1	0.05-.2	meq/L
	Calcium	0.2	0.11-.2	meq/L
	Magnesium	0.2	0.13-.2	meq/L
	Bicarbonate	0.3	0.17-.3	meq/L
	Chloride	0.1	0.01-.2	meq/L
	EC	0.1	0.04-.1	dS/m
	pH	7.6	7.30-8.0	standard units
	Phosphorus	0.0	0.00-.0	ppm
	Potassium	1.0	0.60-1.5	ppm
	Nitrate	0.0	0.00-.1	ppm
	Sulfate	2.1	1.10-3.9	ppm
	Boron	0.0	0.00-.0	ppm
	TDS	32.4	28.00-41.0	ppm
	adj SAR	2.1	0.10-9.9	-

¹ EC: electrical conductivity; TDS: total dissolved solids; adj. SAR: adjusted sodium adsorption ratio

² meq/L: milliequivalents per liter; dS/m: deciSiemens per meter; ppm: parts per million, equivalent to mg/L

4.2.3 Tile Drain Monitoring

Starting in the 1990s, growers in TID began installing subsurface drainage systems (tile drains) to help control shallow water table levels. Discharge from these subsurface drains enters the TID canal system and becomes a part of the overall water supply. TID has historically sampled and evaluated the water quality of 32 tile drain discharges on a quarterly basis. The samples are analyzed for the same “ag panel” described above, and the data are provided to the Improvement Districts. Growers are encouraged to implement on-farm measures to improve water quality should it not meet TID’s water quality standards. Testing of tile drains has not occurred regularly in recent years on account of staffing constraints.

Table 4.9. Summary of TID Water Quality Monitoring Results for Historical Years

Source	Constituent	Average	Range	Units	Year Range
Tile Drains	Sodium	3.9	0.22-28.1	meq/L	2013-2015
	Calcium	5.4	0.4-8.6	meq/L	2013-2015
	Magnesium	2.8	0.2-6.3	meq/L	2013-2015
	Bicarbonate	5.7	0.7-11.8	meq/L	2013-2015
	Chloride	2.4	0.1-30.1	meq/L	2013-2015
	EC	1.3	0.1-4.7	dS/m	2013-2015
	pH	7.1	6.4-7.9	standard units	2013-2015
	Phosphorus	3.3	0.1-9.9	ppm	2013-2015
	Potassium	25.6	1.4-93.2	ppm	2013-2015
	Nitrate	196.0	2.0-436.0	ppm	2013-2015
	Sulfate	60.7	4.0-244.0	ppm	2013-2015
	Boron	0.2	0.01-1.2	ppm	2013-2015
	TDS	956.6	74-2,896	ppm	2013-2015
	adj SAR	2.5	0.2-13.3	-	2013-2015
Drainage Pumps	TDS	753	309-1,607	ppm	2000-2009
	Boron	0.10	0.01-0.42	ppm	2000-2009
Rented Pumps	TDS	727	193-2,179	ppm	2002-2009
	Boron	0.10	0.01-0.82	ppm	2002-2009

4.2.4 Real-time Canal Monitoring

In 2005 TID began installing water quality telemetry to better understand the quality of water within the canal and drainage system. TID installed YSI 600XL multi-parameter water quality sondes at 18 canal and drain spill locations and is now replacing these sensors with In-situ Aqua Troll 100 sondes. These sondes measure EC and temperature on a real-time basis. The data is uploaded into TID’s SCADA system where it can be viewed by staff. The data is useful in determining how canal water quality changes as a result of different operational scenarios.

4.2.5 Irrigated Lands Regulatory Program Monitoring

Between 2004 and 2010, TID performed additional water quality sampling and reporting in compliance with the Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands (Irrigated Lands Regulatory Program). During that time, TID sampled three spill locations twice during the irrigation season and two spill locations twice during a storm event.

Samples were collected and analyzed for general water quality parameters (pH, EC, Dissolved Oxygen (DO), temperature, turbidity, TDS, Total Organic Carbon (TOC), Total Kjeldahl Nitrogen (TKN), phosphorus and potassium) as well as the active ingredients of any pesticides or herbicides utilized by TID along the canals, which included up to eleven active ingredients from herbicides used for terrestrial weed control purposes.

Beginning in 2011, TID joined the East San Joaquin Water Quality Coalition (ESJWQC) for coverage under the Irrigated Lands Regulatory Program (ILRP). Members of the ESJWQC collective pay for administering a group permit for compliance with the ILRP. As of January 2019, the ESJWQC represents over 2,600 members and over 572,000 acres east of the San Joaquin River. The ESJWQC aims to characterize discharge from irrigated agricultural lands, identify locations and potential sources of water quality violations, and promote water quality management practices among landowners. Toward these goals, the ESJWQC has an extensive monitoring program that surveys a wide variety of constituents in a number of local drains and canals. The program is designed to rotate throughout the watershed, and as a result, the sampling locations and constituents are subject to change.

A new Waste Discharge Requirements (WDR) order for the ESJWQC was approved by the Regional Water Quality Control Board (RWQCB) in December 2012, which brought groundwater into the regulatory framework of the ILRP. While surface water monitoring continues under the new WDR, the new program is focused more on a management approach with an emphasis on managing inputs of various pollutants (e.g. nutrients and sediment) rather than strictly focusing on water quality monitoring. Toward this effort, the ESJWQC developed and is implementing a Nitrogen Management Plan (NMP) which requires growers to document how much nitrogen is added and removed from their lands. This information is then submitted to the Coalition once per year, which summarizes and reports it to the RWQCB. A Sediment and Erosion Control Plan was also developed. The template for the plan has been approved by RWQCB staff and is now being sent to growers whose farms have the potential to discharge sediment to off-farm surface water. Growers can complete and submit the template to the Coalition if they have attended training, or they can have a trained and certified individual complete and submit the template for them.

Under the new WDR, the ESJWQC also completed a Groundwater Assessment Report (GAR) and submitted it to the RWQCB in 2014. The GAR compiled all available groundwater data (both level and quality) to identify high and low vulnerability areas within the Coalition. These designations will then be used while implementing the plans described above. In addition, the ESJWQC must develop and implement a groundwater trend monitoring program. The ESJWQC began sampling groundwater wells in 2018 to comply with the Groundwater Trend Monitoring Program. The first trend analysis will be performed within the next three years, then subsequently every five years.

Since the 2012 WDR adoption, ESJWQC and other Central Valley coalitions collectively formed the Central Valley Groundwater Monitoring Collaborative (CV-GMC). This will allow the ESJWQC to pool data and resources with the other coalitions to meet the requirements of the groundwater trend monitoring program. Together, the coalitions have produced five-year reports and cooperated on other technical issues related to groundwater monitoring, such as development of a single database to house groundwater results that enables efficiencies in shared reporting and data management. Future collaboration opportunities with other groundwater monitoring

programs include data gathering for SGMA-related efforts and the Surveillance and Monitoring Program (SAMP) under the Central Valley Salinity Alternatives for Long-term Sustainability (CV-SALTS).

As members of the ESJWQC, TID continues to coordinate with ESJWQC staff regarding water quality issues. To facilitate this process, a TID staff member has served on the ESJWQC Board of Directors and regularly attends Coalition meetings. Information from the 2012 WDR will provide additional information regarding surface and groundwater quality in the TID service area.

4.2.6 Aquatic Pesticide Permit

TID maintains coverage for its applications of Magnacide-H and endothall-based herbicides under the Statewide General NPDES Permit for Residual Aquatic Pesticide Discharges. Both the Magnacide-H and endothall products are aquatic herbicides for the control of submerged aquatic weeds and algae. These products are used in the District's canals, along with mechanical removal and other practices necessary to maintain the flow of water in the canal system. In 2016, TID submitted a new Aquatic Pesticide Application Plan (APAP) for two additional aquatic herbicides: glyphosate and imazamox. These are also used for treating emergent aquatic weeds in the drains and along the sides of the canals.

As part of the permit, monitoring is required for general water quality parameters (pH, EC, DO, temperature and turbidity) as well as the active ingredient of the permitted herbicide.

4.2.7 Source Water Quality Monitoring

The surface water supply for TID originates as snowmelt from the Sierra Nevada Mountains and is of very high quality. Water quality is regularly tested at Turlock Lake as part of TID's Ag Suitability monitoring program. Results of these tests (**Table 4.8**) show that source water diverted from the Tuolumne River has an average TDS of 32 parts per million (ppm), nitrate concentration of less than 0.1 ppm, phosphorus concentration of less than 0.01 ppm, and potassium concentration of less than 2 ppm. This high quality water poses no restrictions for irrigation. However, some growers do need to add gypsum to heavier soils to overcome infiltration problems associated with such low TDS water.

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5. Water Accounting and Water Supply Reliability

5.1 INTRODUCTION

This section describes the various water uses and water supplies within TID, providing an overall picture of how TID’s water supplies are used to meet water demands within the District’s service area. The water budget is provided to quantify all significant inflows and outflows of water to and from key accounting centers within the District.

The water budget presented in this AWMP covers the most recent 5-year period from 2020 through 2024. To understand TID’s conjunctive management approach to water resources management, it is also useful to take a longer view to identify changes in water supplies and water uses over time, as well as the differences between normal and dry years. Consequently, average volumes from the 2014 through 2024 water budget are also reported.

The water uses and water budgets are also discussed in relation to hydrologic conditions, which vary from year to year. Key hydrologic drivers of water management in a given year include available surface water supply based on Don Pedro Reservoir inflows, precipitation within the TID service area, and evaporative demand. Average water budget results are reported for both normal years (years with 48 inches of available water) and dry years (years with less than 48 inches of available water).

Water budget results presented in this AWMP section are provided on an annual basis. The typical irrigation season in TID begins in March and extends into October and occasionally November, straddling two DWR-defined water years (October 1 to September 30). Water year summaries of the complete TID water budget are included in **Appendix H**.

5.2 WATER BUDGET OVERVIEW

The TID water budget includes four separate accounting centers that are used to quantify all major flows of water downstream of La Grange Dam. The accounting centers are:

1. Upper Main Canal represents the canal system from La Grange Diversion Dam to the inflow to Turlock Lake including Dawson’s Lake.
2. Turlock Lake
3. Distribution System Below Turlock Lake represents the water conveyance system from Turlock Lake to the terminus of each canal at spill sites into the San Joaquin River System (Includes Merced and Tuolumne Rivers).
4. Irrigated Lands Below Turlock Lake represent lands within the TID Service Area that receive at least one surface water delivery during the year. Excludes a small area of land within the TID Service area that irrigates only with privately pumped groundwater.

A total of 38 individual flow paths are quantified as part of the water budget. A schematic of the water budget structure is provided in **Figure 5.1**.

In general, flow paths are quantified on a monthly basis using available TID data sources, weather data sources, and root zone water budget model results (described in **Section 5.3**). For each accounting center, all but one flow path is determined independently based on measured

data or calculated estimates. The remaining flow path is then calculated based on the principal of conservation of mass (**Equation 5-1**), which states that the difference between total inflows and outflows to an accounting center for a given period of time is equivalent to the change in stored water within that accounting center.

$$\text{Inflows} - \text{Outflows} = \text{Change in Storage (monthly time step)} \quad [5-1]$$

The flow path that is calculated as the difference between all other inflows and outflows is referred to as the “closure term” because the mass balance equation is solved or “closed” for the unknown quantity. The closure term is selected based on consideration of the availability of data or other information to support an independent estimate, as well as the volume of water representing the flow path relative to the size of other flow paths. Generally speaking, the largest, most uncertain flow path is selected as the closure term. The closure term is indicated in blue in **Figure 5.1**.

5.3 WATER BUDGET CALCULATION AND UNCERTAINTY

Monthly volumes for the flow paths shown in **Figure 5.1** were estimated based on direct measurements or based on calculations using measurements and other data. As described previously, those flow paths not estimated independently were calculated as the closure term of each accounting center.

The data sources and methodologies used to quantify these flow paths are described below.

5.3.1 Surface Water and Groundwater Data Sources

This section describes the data sources used to quantify TID’s surface water supplies and deliveries, as well as surface water supplies from other water sources. Drainage, evaporation, and infiltration of surface water are also described below.

5.3.1.1 TID Surface Water Supplies and Deliveries

TID’s surface water supplies from Don Pedro Reservoir are diverted at the La Grange Diversion Dam into the Upper Main Canal for conveyance to Turlock Lake. Releases from La Grange Dam are measured at a stream gage site maintained by the United States Geological Survey (USGS). From Turlock Lake, water is released into the Main Canal for distribution to downstream growers for irrigation or for non-irrigation purposes, such as flood releases from Don Pedro Reservoir. Outflows from Turlock Lake are measured using a broad-crested weir and recorded by TID.

Farm deliveries are calculated as the water balance closure for the TID Distribution System accounting center. TID also measures and records deliveries to irrigators in its TXDB database system, which has been modified in recent years to better track ordering, measurement, and billing data to meet the SBx7-7 requirements. The farm deliveries closure is compared to the sum of all recorded deliveries each year as a check for the overall accuracy of TID’s recorded deliveries and water balance.

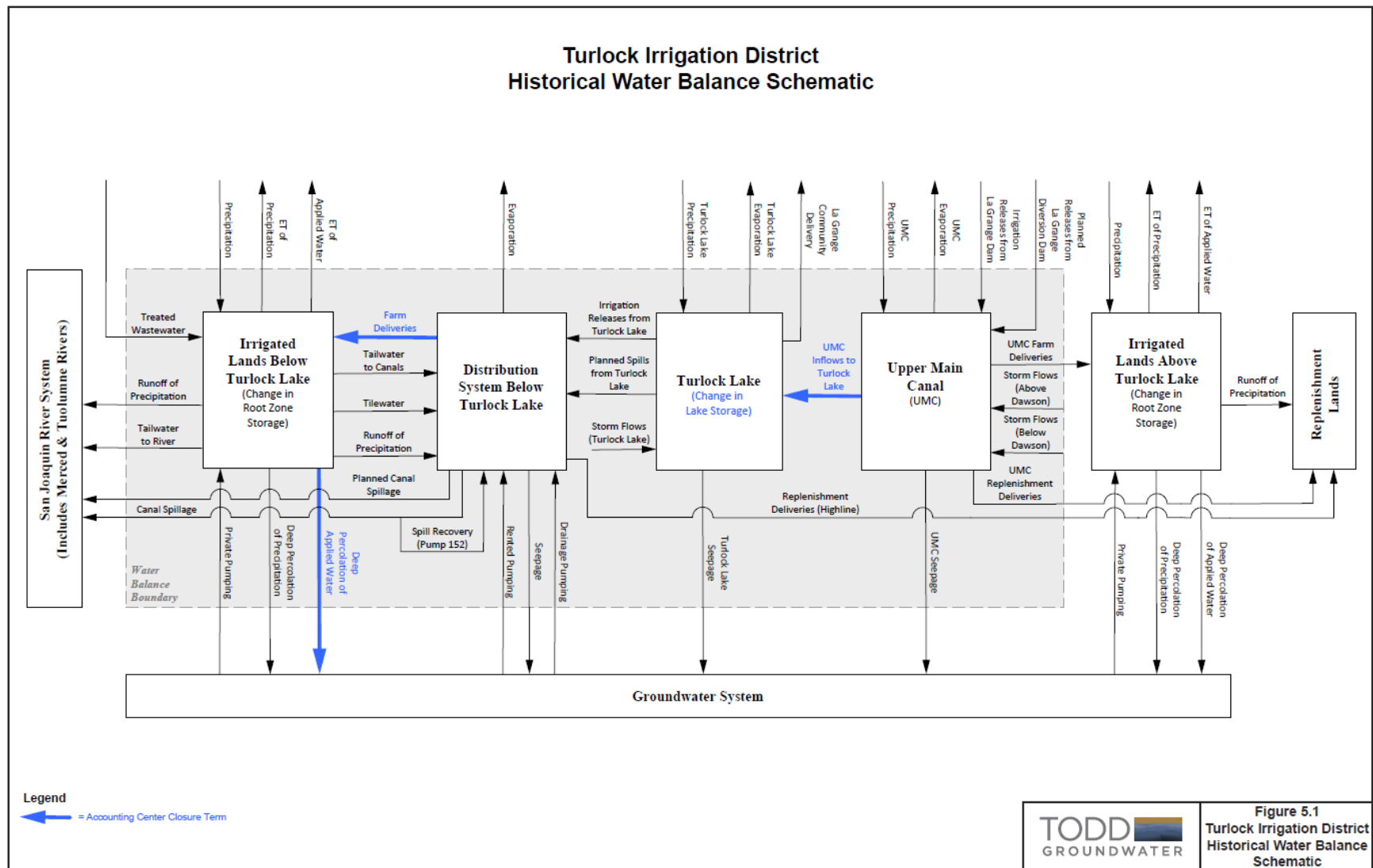


Figure 5.1. TID Historical Water Balance Schematic

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5.3.1.2 TID Groundwater Pumping

TID practices conjunctive management of surface water and groundwater, supplementing surface water releases by pumping groundwater from drainage wells and rented wells. Water pumped from drainage wells and rented wells discharges either directly into a canal, into a pipeline that flows back to a canal, or into a pipeline that is utilized for irrigation purposes.

Drainage wells are owned and operated by TID primarily to lower groundwater levels in localized, high groundwater areas and to supplement other irrigation water supplies. Rented wells are owned by private parties or IDs, and are rented by TID to supplement irrigation supplies, particularly in drier years when surface water supplies are limited. Both drainage and rented pumping volumes are calculated based on power meter records for individual wells multiplied by a power factor derived from pump tests.

5.3.1.3 Private Groundwater Pumping

As described in **Section 2**, private pumping volumes in TID are calculated using a conversion factor that correlates the quantity of water pumped with electrical energy use. TID has reviewed and revised the conversion factor on several occasions, most recently in 2021. Revisions to this methodology have helped to improve the accuracy of private pumping volumes and to prevent overestimation resulting from other electricity usage associated with the same electric meter. TID will continue to review and revise the conversion factor in the future, as needed.

In some dry years, TID allows growers to pump groundwater into the canals and receive a delivery “credit” equal to the volume they supply at any sidegate serving their property. This practice supplements the supply available to downstream users and provides growers flexibility to deliver pumped water to any of their fields with an active sidegate. Pump-for-credit water is tracked as a separate flow path in the water balance using a conversion factor that relates the volume pumped to electrical energy usage, similar to the method used for private groundwater pumping. TID periodically updates the conversion factors for pumps participating in this program to maintain accuracy.

5.3.1.4 Other Water Supplies

Other surface water supplies available to irrigators in TID include subsurface drainage (tilewater), surface drainage (tailwater), spillage recovery, treated wastewater, and storm flows.

Subsurface drainage, or tilewater drainage, from fields in TID is calculated as the sum of all measured, calculated, or estimated tilewater from 35 tile drain systems. Most of the tilewater drainage is calculated from power meter records using a power factor that was derived from tile drain systems with both flow meter records and power meter records. Some tile drain systems are measured with flow meters, while the remaining few are estimated based on historical average drainage values. Subsurface discharge from all tilewater drains enters the TID distribution system, where it blends with surface water supplies and becomes available for deliveries downstream.

Tailwater drainage from irrigated lands in TID is estimated as 0.42% of the recorded deliveries for 2014-2024. The estimated percentage is based on available records at Woods Drain and an inventory of tailwater drainage from lands in TID that was first conducted in 2004 and later

updated in 2009. This inventory found that tailwater drainage only comes from a small percentage of lands within TID, with approximately 2,700 acres generating tailwater that flows to District canals, and an additional 8,200 acres generating tailwater that drains to natural waterways adjoining TID.¹²

TID also recovers spillage from Harding Drain at Pump 152, which pumps into Lateral 5.5 to supply downstream deliveries. The volume of spillage recovery is calculated by TID based on power meter records multiplied by a power factor derived from pump tests. The TID distribution system is also designed to provide passive spillage recovery from the upper laterals through interception by the Ceres Main Canal, and spillage recovery from 34 ID pipelines that spill into canals. This passive spillage recovery is an internal flow path within the TID distribution system and is not included in the water budget.

Recycled water comes to farms from a variety of sources, including recycled treated wastewater from the City of Modesto and City of Turlock, and untreated dairy nutrient water and industrial process water from Hilmar Cheese Company. City of Modesto and Hilmar Cheese Company each report the volumes they delivered. The City of Turlock is not currently providing recycled water for use outside of city parks and other city facilities; however, they historically provided recycled water for agricultural use and could in the future.

Rainfall runoff from upslope watersheds that flow into the TID distribution system are quantified using Hydrocomp Forecast and Analysis Model (HFAM) software. HFAM simulates hydrologic processes utilizing both historical and real-time data illustrating how watershed behavior will impact TID's distribution system. The model is run annually and output is used in the water balance to quantify the runoff that flows into TID distribution system.

5.3.1.5 Spillage, Evaporation, and Canal Seepage

Losses from the distribution system at the water supplier scale include seepage, spillage, and evaporation. Of the three loss types, only evaporation losses are non-recoverable as seepage recharges the underlying groundwater system and spillage is available by downstream water users.

Canal spillage from the TID distribution system is measured and recorded by TID's extensive network of SCADA sites. SCADA equipment is installed at 14¹³ spillage sites located at the ends of lower laterals and main canals (see the District Map in **Appendix D**). The TID distribution system is designed so that upper laterals terminate into the lower delivery canals, allowing any excess water in the upper laterals to be utilized for deliveries from the lower canals before spillage occurs. Water in the canals that is not utilized for irrigation purposes is released into drains or downstream rivers at the spillage sites. Six of the spillage sites flow directly to rivers, while the remaining spillage is consolidated into three drains that flow to the river system.

¹² The 2009 updated inventory of tailwater drainage from TID lands identified particular fields that generate tailwater and drain to canals or to the river system. Tailwater to rivers was not estimated prior to 2009 due to lack of available data.

¹³ There are 15 operational spillage sites in the TID system. However, only 14 are used. The 15th site can spill, but is very rarely used, and therefore is not included in the SCADA system at this time.

Evaporation from the TID distribution system is calculated as the canal water surface area multiplied by a water surface evaporation coefficient¹⁴ and by daily ET_o ,

Seepage (groundwater recharge) from the Upper Main Canal and distribution system below Turlock Lake is calculated based on published seepage rates by soil type, estimated canal wetted areas, and wetted duration during the irrigation season when water is flowing through TID canals. Representative ponding tests have also been conducted in the past to provide spot checks of the seepage rates. Seepage from Turlock Lake is based on a linear relationship with seepage rate as a function of lake level developed from ponding tests at varying water depths and surface areas.

5.3.2 Weather and Climate Data Sources

Precipitation data measured at the CIMIS Station #206 “Denair II” (37.5459, -120.7545) are used for the 2014-2024 period.

Reference evapotranspiration (ET_o) data are likewise reported by CIMIS Station # 206. ET_o rates are used to calculate evaporation from TID canals, and for calculating crop evapotranspiration (ET_c) in the root zone water budget model, described in the next section.

5.3.3 Irrigated Lands Root Zone Water Budget Model

5.3.3.1 Background

A daily root zone water budget model was used to support water budget development for the TID Irrigated Lands accounting center. A daily root zone water budget is a generally accepted and widely used method to accurately and consistently calculate crop evapotranspiration (ET_c), effective precipitation, crop consumptive use of applied irrigation water, and other water budget flow paths in the root zone (ASCE, 2016 and ASABE, 2007).

Flows through the root zone and plant surfaces were modeled using the Integrated Water Flow Model (IWFM) Demand Calculator, referred to as IDC. The physically-based IDC version 2015.0.0036 (DWR, 2015) is developed and maintained by DWR. Similar to the water budgets described in this AWMP, the IDC root zone water budget calculates a daily balance of inflows and outflows to and from the root zone and crop surfaces. Key inputs required by IDC include weather and climate data, soil characteristics, and crop characteristics. IDC uses these inputs to accurately calculate the balance of inflows and outflows, and to parse ET_c into the fractions of crop consumptive use met by precipitation (effective precipitation, or ET of precipitation) and by applied irrigation water (ET of applied water).

The TID IDC root zone water budget model was used to develop time series estimates for the following flow paths:

- Evapotranspiration of applied water, or ET_{aw} (also referred to as crop consumptive use of applied irrigation water)

¹⁴ Free surface evaporation coefficient of 1.05, obtained from ASCE, 1990

- Evapotranspiration of precipitation, or ET_{pr} (also referred to as effective precipitation¹⁵)
- Deep percolation of precipitation, or DP_{pr} ¹⁶
- Uncollected surface runoff of precipitation
- Change in storage of root zone soil moisture from precipitation

5.3.3.2 Required IDC Inputs and Data Sources

Major required inputs provided to the IDC root zone water budget model are summarized below, along with their respective data sources.

5.3.3.2.1 Crop Evapotranspiration

Daily crop evapotranspiration (ET_c) rates are quantified and provided to the TID IDC application for crops and land uses in TID. ET_c inputs to the TID IDC represent actual ET (ET_a) (as compared to potential ET) for the water budget period. ET_c rates are calculated by multiplying daily reference ET (ET_o) by the appropriate crop coefficient for each crop and land use. Daily ET_o rates are reported by CIMIS stations in and around TID, as described in the previous section. Local crop coefficients are developed from ET_a estimates calculated using remotely sensed surface energy balance results over nine recent years.¹⁷ Two surface energy balances were applied to calculate ET_a in TID: Mapping EvapoTranspiration at high Resolution with Internalized Calibration (METRIC) and Surface Energy Balance Algorithm for Land (SEBAL). METRIC and SEBAL results both account for the many factors that impact ET_c , including crop age, vegetation density, disease, salinity, deficit irrigation, and other stress factors. Studies by Bastiaanssen, et al. (2005), Allen, et al. (2007), Thoreson, et al. (2009), Allen, et al. (2011), and others have found that seasonal ET_a estimates by these models are expected to be within plus or minus five to fifteen percent of actual ET when performed by an expert analyst.

5.3.3.2.2 Precipitation

Daily precipitation data provided as inputs to the IDC model were derived from the weather stations described in **Section 5.3.2**. Daily precipitation rates are used by IDC to quantify ET_{pr} (or effective precipitation, as noted in **Section 5.3.3.1**), DP_{pr} , runoff of precipitation, and change in storage of root zone soil moisture from precipitation. IDC calculates a daily precipitation accounting that balances the precipitation inflow with these other outflows and change in storage.

5.3.3.2.3 Soil Characteristics

Soil characteristics for the predominant soil textures in TID are required for IDC to simulate the availability of soil moisture in the root zone. Soil textural classes and associated soil hydraulic parameters were estimated from the Soil Survey Geographic (SSURGO) database (Soil Survey Staff, 2014) for use in IDC. The SSURGO database contains information collected by the

¹⁵ Effective precipitation is defined as the portion of total precipitation that remains on the foliage or in the soil that is available for evapotranspiration, and reduces the amount of applied water required for evapotranspiration (ET_{aw}) by a like amount (ASCE, 2016).

¹⁶ Deep percolation of applied water (DP_{aw}) is also calculated by IDC based on deliveries estimated by IDC. However, because farm deliveries are available from the water balance, DP_{aw} served as the Irrigated Lands water budget closure term.

¹⁷ SEBAL results are available for 2009, and METRIC results are available for 1997, 1998, 2000, 2001, 2002, 2008, 2010, and 2013.

National Cooperative Soil Survey (NCSS) about soils in the United States. The United States Department of Agriculture Natural Resources Conservation Service (USDA NRCS), formerly known as the Soil Conservation Service (SCS), organizes the NCSS and publishes soil surveys.

The following soil parameters are based on SSURGO data for soils in TID:

- Permanent wilting point (PWP), dimensionless
- Field capacity (FC), dimensionless
- Total porosity (ϕ), dimensionless
- Pore size distribution index (λ), dimensionless
- Saturated hydraulic conductivity (K_{sat}), in feet per day (ft/day)

A description of each parameter and its role in IDC is provided in the IDC documentation prepared and published by DWR.¹⁸

5.3.3.2.4 Other Irrigation and Crop Characteristics

Other key characteristics are also required by IDC to define irrigation periods, irrigation practices, and crop development in TID:

- Irrigation period: Identification of days in each year when crops are irrigated or non-irrigated.
- Target soil moisture fraction: Dimensionless fraction of field capacity to establish the level of soil saturation targeted by irrigation
- Minimum soil moisture: Dimensionless fraction of field capacity to establish the minimum soil saturation at which irrigation begins
- Runoff curve numbers: Dimensionless number relating the relative runoff characteristics of each soil (and crop surface) in TID. IDC uses a modified version of the SCS curve number (SCS-CN) method to compute runoff of precipitation. Curve numbers are used as described in the National Engineering Handbook Part 630 (USDA, 2004, 2007) based on land use or cover type, treatments (straight rows, bare soil, etc.), hydrologic condition, and hydrologic soil group.
- Rooting depth: Depth of crop roots as the irrigation season progresses, in feet.

A description of each parameter and its role in IDC is likewise provided by DWR in the IDC documentation available online at the link below.

5.3.4 Accounting Center Closure Terms

The monthly volume of inflow to Turlock Lake is calculated as the closure term of the Upper Main canal accounting center. It was selected as the closure term because it represents the largest unmeasured flow path for the Upper Main Canal accounting center.

The monthly change in storage of Turlock lake is calculated as the closure term for the Turlock Lake accounting center. The closure term is compared to an estimate of the actual change in

¹⁸ DWR IDC documentation available online at: <https://water.ca.gov/Library/Modeling-and-Analysis/Modeling-Platforms/Integrated-Water-Flow-Model-Demand-Calculator>

storage based on the change in water level in Turlock Lake. The comparison provides a check on the accuracy of the estimated and measured inflows and outflows from Turlock Lake.

The monthly volume of farm deliveries are calculated as the closure term for the TID Distribution System accounting center. Farm deliveries were selected as the closure because they represent the largest outflow from the TID distribution system, and historically they were subject to the inaccuracies inherent in TID's use of sidegates as delivery measurement devices. As described in **Section 2.2.2.2**, delivery measurements have substantially improved in accuracy as a result of TID's delivery measurement accuracy improvement program and other efforts following SBx7-7. Alongside these improvements, TID has also increased the accuracy of other distribution system flow paths with the expansion and enhancement of its SCADA system. Consequently, farm deliveries are still calculated as the Distribution System accounting center closure. The closure is compared with delivery records each irrigation season to verify the completeness and overall accuracy of both the delivery records and the TID water budget.

Deep percolation of applied water (DP_{aw}) is calculated as the closure term for the TID Irrigated Lands accounting center, which includes all lands served by TID deliveries. Deep percolation of applied water was selected as the closure because it represents a relatively large outflow from irrigated lands to the groundwater system, and it is difficult to measure accurately.

5.3.5 Flow Path Uncertainty

The results of the TID water budget are reported for each flow path with a high level of precision (nearest whole acre-foot) that implies a higher degree of accuracy in the values than is actually justified. To identify the level of uncertainty associated with each flow path, an estimated percent uncertainty has been defined for each measured or estimated flow path, approximately representing a 95 percent confidence interval. These uncertainty values are quantified based on the accuracy of measurement devices, typical values quantified in other water budgets, or professional judgment. Then, based on the relative magnitude of each flow path, the resulting uncertainty in each closure term can be estimated by assuming that errors in estimates are random, following the procedure described by Clemmens and Burt (1997). Errors in estimates for individual flow paths may cancel each other out to some degree, but the net error due to the collective uncertainty in the various flow paths is ultimately expressed in the closure term.

Table 5.1 through 5.4 lists each flow path included in the water budget for each of the four accounting centers, whether it is an inflow or an outflow, whether it was measured or calculated, the supporting data used to determine it, and the estimated uncertainty, expressed as a percent. As indicated, estimated uncertainties vary by flow path from two percent to one hundred percent of the estimated value, with uncertainties generally being less for measured flow paths and greater for calculated flow paths. The estimated uncertainty of each closure term is also shown, calculated based on the concept of propagation of random errors as described above.

As indicated, the estimated uncertainty in farm deliveries is six percent. This uncertainty is relatively small due to the relatively low uncertainty in system inflows from Turlock Lake, which represent the largest flow path in the distribution system balance. The estimated uncertainty in deep percolation of applied water is 58 percent. Despite the inevitable uncertainties in some estimated flow path quantities, the water budget provides useful insights into TID's water management.

SECTION FIVE

WATER ACCOUNTING AND WATER SUPPLY RELIABILITY

Table 5.1. TID Water Budget Flow Paths, Supporting Data, and Estimated Uncertainty for Upper Main Canal (2020-2024).

Direction	Flow Path	Supporting Data	Source	Average Calendar Year Volume, AF	Estimated Uncertainty, %
Inflows	Irrigation Releases	USGS Site	Measurement	467,247	5%
	Planned Releases	USGS Site	Measurement	29,407	5%
	Storm Flows	From HFAM model	Calculation	2,826	50%
	Precipitation	Quality-controlled precipitation from Denair CIMIS station, Upper Main Canal Estimated Surface Area	Calculation	182	30%
Outflows	Inflow to Turlock Lake	Difference of total inflows and measured/estimated outflows for Upper Main Canal	Closure	483,332	5%
	Seepage	NRCS soils data, published seepage rates by soil type, estimated wetted area, estimated wetted duration, representative ponding tests	Calculation	13,899	35%
	Farm Deliveries	Review of Delivery Measurement Program reported accuracy	Calculated	1,409	10%
	Evaporation	CIMIS reference ET (Denair CIMIS station), estimated evaporation coefficient, estimated wetted surface area	Calculation	977	30%
	Replenishment Deliveries	Review of Delivery Measurement Program reported accuracy	Calculated	10	10%
	La Grange Community Delivery	Review of Delivery Measurement Program reported accuracy	Calculated	34	10%

SECTION FIVE

WATER ACCOUNTING AND WATER SUPPLY RELIABILITY

Table 5.2. TID Water Budget Flow Paths, Supporting Data, and Estimated Uncertainty for Turlock Lake (2020-2024).

Direction	Flow Path	Supporting Data	Source	Average Irrigation Season Volume, AF	Estimated Uncertainty, %
Inflows	Inflow to Turlock Lake	Difference of total inflows and measured/estimated outflows for Upper Main Canal	Closure	483,332	5%
	Precipitation	Quality-controlled precipitation from Denair CIMIS station, Upper Main Canal Estimated Surface Area	Calculation	1,909	30%
	Storm Flows	From HFAM model	Calculation	806	50%
Outflows	Irrigation Releases	Broad-crested weir measurement site just downstream of Turlock Lake	Measurement	423,713	3%
	Planned Releases	Broad-crested weir measurement site just downstream of Turlock Lake	Measurement	29,205	3%
	Seepage	NRCS soils data, published seepage rates by soil type, estimated wetted area, estimated wetted duration, representative ponding tests	Calculation	22,256	35%
	Evaporation	CIMIS reference ET (Denair CIMIS station), estimated evaporation coefficient, estimated wetted surface area	Calculation	11,085	30%
	Change in Reservoir Storage	Difference of total inflows and measured/estimated outflows for Turlock Lake	Closure	-213	-8,624%

SECTION FIVE

WATER ACCOUNTING AND WATER SUPPLY RELIABILITY

Table 5.3. TID Water Budget Flow Paths, Supporting Data, and Estimated Uncertainty for Distribution System Below Turlock Lake (2020-2024)

Direction	Flow Path	Supporting Data	Source	Average Irrigation Season Volume, AF	Estimated Uncertainty, %
Inflows	Irrigation Releases	Broad-crested weir measurement site just downstream of Turlock Lake	Measurement	423,713	3%
	Planned Releases		Measurement	29,205	3%
	TID Drainage Pumping	Pump power use measurements	Measurement	32,623	20%
	TID Rented Well Pumping		Measurement	30,706	20%
	Pump for Credit		Measurement	2,989	10%
	Spill Recovery		Measurement	1,859	20%
	Tilewater	Flow meter where reliable records available, remainder based on power use	Measurement	7,341	10%
	Storm Flows	Estimated from Hydrocomp HFAM Model or Off-season closure term	Calculation	3,043	50%
	Tailwater to Canals	Estimated as a percentage of deliveries to the specific parcels identified as draining to canals for 2009-2011	Calculation	1,013	50
	Runoff of Precipitation to Canals	IDC analysis, CIMIS precipitation data, NRCS curve number method	Calculation	54	35%
Outflows	Farm Deliveries (Closure)	Difference of total inflows and measured/estimated outflows for Distribution System accounting center	Closure	405,652	6%
	Canal Spillage	TID operational spill measurements, predominately Cipoletti weirs	Measurement	50,382	9%
	Planned Spillage		Measurement	28,509	9%
	Seepage	NRCS soils data, published seepage rates by soil type, estimated wetted area, estimated wetted duration, representative ponding tests	Calculation	44,176	35%
	Evaporation	CIMIS reference ET (Denair CIMIS station), estimated evaporation coefficient, estimated wetted surface area	Calculation	1,710	30%
	Replenishment Deliveries (Highline)	Delivery Records	Calculated	2,115	10%

SECTION FIVE

WATER ACCOUNTING AND WATER SUPPLY RELIABILITY

Table 5.4. TID Water Budget Flow Paths, Supporting Data, and Estimated Uncertainty for Irrigated Lands Below Turlock Lake (2020-2024)

Direction	Flow Path	Supporting Data	Source	Average Irrigation Season Volume, AF	Estimated Uncertainty, %
Inflows	Farm Deliveries (Closure)	Difference of total inflows and measured/estimated outflows for Distribution System accounting center	Closure (Distribution System Below Turlock Lake)	405,652	6%
	Precipitation Irrigated Lands	Quality-controlled precipitation from Denair CIMIS station, TID cropped area	Calculation	123,765	10%
	Private Pumping with Surface	Estimated groundwater only area, average TID ETaw and CCUF	Calculation	79,943	20%
	Treated Waste Water	Measurements received from City of Modesto, Hilmar Cheese, City of Turlock, and Treated Wastewater prorated based on days in the irrigation season	Measurement	4,689	10%
Outflows	Deep Percolation of Applied Water	Difference of total inflows and outflows for Farmed Lands accounting center applied water balance	Closure (Applied Water Balance)	113,669	58%
	Evapotranspiration of Applied Water	CIMIS reference ET, estimated crop coefficients based on SEBAL 2009 analysis, cropped area by crop, Integrated Water Flow Model Demand Calculator (IDC) analysis to divide total ET into applied water and precipitation components	Calculation	364,036	10%
	Evapotranspiration of Precipitation		Calculation	69,639	10%
	Tilewater	Flow meter where reliable records available, remainder based on power use	Measurement	7,341	10%
	Tilewater to River System		Measurement	987	35%
	Tailwater to Rivers	Estimated as a percentage of deliveries to the specific parcels identified as draining to canals for 2009-2011	Calculation	3,238	35%
	Tailwater to Canals		Calculation	1,013	25%
	Deep Percolation of Precipitation	IDC analysis, NRCS soils characteristics, CIMIS precipitation data	Calculation	68,229	10%
	Runoff of Precipitation to Canals	IDC analysis, CIMIS precipitation data, NRCS curve number method	Calculation	54	35%
	Runoff of Precipitation to Rivers		Calculation	236	35%
	Storage of Precipitation (RZ-PR)	Difference of total inflows and outflows for Farmed Lands accounting center precip water balance	Closure (Precipitation Balance)	-14,393	154%

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5.4 HYDROLOGIC YEAR TYPES FOR EVALUATION OF WATER MANAGEMENT

Development of a multi-year water budget allows TID to better evaluate the effects of surface water supply variability, precipitation variability, and other hydrologic changes as they impact water management in TID. Specifically, a multi-year water budget that includes both dry and normal years is essential to evaluate and plan for conjunctive management as practiced by TID. This multi-year water budget also supports the EWMP planned conjunctive use of surface water and groundwater that is discussed in **Section 7**.

To support the review and interpretation of water uses and water supplies over time, the TID water budget is presented alongside the depth of annual available water according to the assignment determined each year by the TID Board of Directors (see **Section 2.2.3**) and related water year types. **Table 5.5** shows the annual available water and water year type for 2020-2024 together with the total calendar year precipitation and reference evapotranspiration (ET_o), compared to average values across 2014-2024 long-term period.

Years with reduced inflows to Don Pedro Reservoir due to reduced precipitation in the watershed typically correspond to years with reduced precipitation and increased evaporative demand in the TID service area. Based on the annual amount of water generally available to growers, the years 2014-2024 have been assigned to normal or dry year types for purposes of discussing water uses and water supplies in TID over time. As described in **Sections 2 and 3**, the TID Board of Directors determines (1) the year type (and therefore the water pricing schedule to be used for the given year), and (2) the amount of water available for purchase. In years assigned a normal designation for this analysis, the available water was 48 inches. In years assigned as dry, the available water was less than 48 inches. These year type classifications are for this analysis only and are not meant to correspond with water year classifications used for regulatory or other purposes.

As discussed previously, TID has a reliable source of water from Don Pedro Reservoir through a variety of water rights on the Tuolumne River. TID growers have received full available water supplies (48 inches) in 5 of the last 11 years.¹⁹ During the 2020 to 2024 period, available water was reduced in 2020 through 2022, with full water supplies available in 2023 and 2024.

In the 5-year period from 2020 to 2024, the average calendar year ET_o has been approximately 57.7 inches. Precipitation in the TID service area between 2014 and 2024 averaged approximately 10 inches for dry years and 14 inches for normal years.

¹⁹ Between 1991 and 2012, the available water was considered the allotment or allocation, for purposes of comparing water year types for this report. Starting in 2013, implementation of a volumetric pricing system eliminated the allocation system. Therefore, starting in 2013, available water, for the purposes of this report, is considered the amount of water available equally to each acre of land.

Table 5.5. TID Available Water, Hydrologic Year Type, and Calendar Year Precipitation and ETo

Year	Irrigation Season		Number of Days	Available Water (inches) ¹	Year Type	Precipitation, (inches)	ET _o , (inches)
	Start Date	End Date					
2020	2-Mar	28-Oct	241	42	Dry	6.1	55.9
2021	18-Mar	27-Oct	224	34	Dry	11.7	59.3
2022	28-Mar	12-Oct	199	27	Dry	8.0	60.8
2023	9-Mar	1-Nov	238	48	Normal	14.9	55.1
2024	12-Mar	13-Nov	247	48	Normal	15.8	57.4
2020-2024			Average			11.3	57.7
			Minimum			6.1	55.1
			Maximum			15.8	60.8
2014-2024			Average			12.1	56.7
			Normal Year Average			14.3	55.9
			Dry Year Average			10.2	57.4

¹ Depth of water in inches available equally to each acre of land.

In addition to having reduced surface water supplies and below-normal precipitation, dry years also tend to have slightly higher evaporative demand compared to normal years, resulting in increased crop irrigation requirements. Thus, in dry years TID faces increased irrigation demands while surface water supplies are reduced. As a result, in dry years groundwater use is increased to supplement reduced surface water supplies reflecting TID's conjunctive management approach.

5.5 CALENDAR YEAR WATER BUDGET

The TID water budget structure was shown previously in **Figure 5.1**. The water budget was prepared for four accounting centers:

1. TID Upper Main Canal from La Grange Diversion Dam to the Inflow of Turlock Lake
2. Turlock Lake
3. TID Distribution System, representing TID canals, drains, and facilities below Turlock Lake and
4. TID Irrigated Lands, representing all land that receives deliveries within the TID irrigation service area.

An accounting center representing the groundwater system is also included in **Figure 5.1** to account for exchanges between the vadose zone and the aquifers underlying TID. However, a complete balance for the underlying aquifer is not calculated because not all subsurface inflows and outflows have been estimated as part of the AWMP water budget. Tabulated water budget results for each accounting center are provided in **Tables 5.6 through 5.9**.

In this AWMP section, the water budget is presented on a calendar year basis to more accurately reflect irrigation practices and the TID operations that support them. Using a water year framework can split an irrigation season across two reporting periods, which makes it less effective for describing irrigation activities. Summary results are provided for the 2020 to 2024

period as well as for the 2014 to 2024 period. Underlying the calendar year time step is a more detailed water budget in which all flow paths are determined on a monthly basis or more frequently.

Water year summaries (October 1 through September 30) are provided in **Appendix H**, in compliance with AWMP guidelines.

5.5.1 Upper Main Canal Water Budget

Between 2020 and 2024, total irrigation releases from La Grange Diversion Dam to the Upper Main Canal ranged from approximately 373,000 acre-feet (AF) to 546,000 AF, with an average annual release of about 467,000 AF. Over the 2014–2024 period, irrigation releases in normal years averaged more than 572,000 AF, while dry year releases averaged approximately 392,000 AF, resulting in an overall average of 474,000 AF (**Table 5.6**). Higher releases in normal years reflect the greater availability of surface water supplies.

In addition to releases from La Grange Dam, the Upper Main Canal receives minor contributions from stormwater inflows occurring both upstream and downstream of Dawson Lake. The primary outflow from the canal is to Turlock Lake, which serves as the closure point for the Upper Main Canal accounting center. A measurement site near the inlet to Turlock Lake has been installed and is currently being calibrated. Once operational, this site will provide additional information on conveyance losses between La Grange Dam and Turlock Lake. Revising the closure term to explicitly represent seepage losses could improve the overall water balance.

Canal efficiency is defined as the ratio of total outflows, excluding seepage and evaporation, to total inflows. Based on this definition, efficiency of the Upper Main Canal during the 2020–2024 period ranged from 96 to 97 percent (**Table 5.6**).

5.5.2 Turlock Lake Water Budget

Between 2020 and 2024, total irrigation releases from Turlock Lake ranged from approximately 336,000 AF to nearly 493,000 AF, with an average of about 424,000 AF per year. Over the longer 2014–2024 period, irrigation releases averaged about 487,000 AF in normal years and 356,000 AF in dry years, with an overall average of approximately 416,000 AF (**Table 5.7**). Higher releases in normal years correspond to increased surface water availability.

Inflows to Turlock Lake are derived primarily from the Upper Main Canal, which contributed an average of 483,000 AF during 2020–2024, supplemented by smaller volumes from direct precipitation and storm inflows. Outflows consist predominantly of irrigation releases, with additional components from planned releases, seepage, and evaporation. Seepage from Turlock Lake is actively managed as part of TID’s conjunctive use program. In normal years, higher lake levels are maintained to enhance seepage and promote groundwater recharge, while in dry years lake levels are managed to reduce seepage losses and conserve surface water for irrigation deliveries. Over the 2014–2024 period, average seepage was approximately 35,000 AF in normal years and 14,000 AF in dry years, resulting in an additional 20,000 AF of groundwater recharge in normal years compared to dry years.

The closure for the Turlock Lake accounting center is the monthly change in storage, which is calculated and compared against an independent estimate of storage change derived from lake levels. Close agreement between the two methods indicates greater confidence in both the inflow measurements and the accounting center estimates. Over time, the cumulative average of storage changes should approximate zero, reflecting balance between inflows and outflows. This comparison has historically been used by TID to identify periods when measurement sites may be drifting out of calibration.

5.5.3 Distribution System Water Budget

Over the 2020 to 2024 period, the District distribution system had total irrigation releases from Turlock Lake ranging from approximately 336,000 AF to nearly 493,000 AF, with an average of about 424,000 AF per year. Over the 2014 to 2024 period, normal year irrigation releases averaged over 487,000 AF, and dry year releases averaged approximately 356,000 AF, with an overall average of 416,000 AF. Releases are greater in normal years due to the greater availability of surface water.

Other sources of TID supply include drainage pumping and rented pumping, subsurface drainage (tilewater) and tailwater that drains directly into the distribution system, and treated wastewater that is recycled and discharged to TID irrigated lands.

As shown in **Table 5.8**, TID drainage pumping ranged from 25,000 AF to 40,000 AF between 2020 and 2024, averaging more than 33,000 AF per season. For the 2014–2024 period, the normal-year average was 30,000 AF and the dry-year average was 33,000 AF, resulting in an overall average of 32,000 AF. The consistency of drainage pumping across year types reflects the ongoing need to remove water from the root zone, regardless of hydrologic conditions.

TID rented pumping ranged from 7,000 AF to 60,000 AF between 2020 and 2024. The overall average for the five year period was 31,000 AF. The normal and dry year averages over the 2014 to 2024 period were 8,000 AF and 47,000 AF, respectively, with an overall average of 29,000 AF. Rented pumping generally increases in dry years because rented wells are used as an additional groundwater supply to meet increased irrigation demands and to compensate for reduced surface water availability. As part of conjunctive management, TID intentionally pumps less in normal and wetter years to maximize the use of available surface water and allow for in-lieu groundwater recharge.

For TID, the fraction of supply from surface water provides a means of evaluating variability in TID’s use of surface water supplies compared to groundwater supplies over time. The surface water supply fraction in TID is calculated according to **Equation 5-2**:

Surface Water Supply Fraction = $\text{Irrigation Releases from Turlock Lake} / (\text{Irrigation Releases from Turlock Lake} + \text{Drainage Pumping} + \text{Rented Pumping})$

Table 5.6. Upper Main Canal Water Budget Results, Acre-Feet¹

Available Water (inches) ²	Year	Total Releases from La Grange Dam	Inflows					Outflows						UMC Efficiency ³
			Planned Releases from La Grange Dam	Irrigation Releases from La Grange Dam	UMC Precipitation	Storm Flows (Above Dawson)	Storm Flows (Below Dawson)	UMC Inflows to Turlock Lake	UMC Farm Deliveries	UMC Replenishment Deliveries	La Grange Community Delivery	UMC Evaporation	UMC Seepage	
20	2014	351,557	0	351,557	35	787	18	339,082	1,374	0	34	891	11,016	97%
18	2015	317,119	0	317,119	27	320	10	304,426	1,374	0	34	860	10,782	97%
36	2016	432,492	0	432,492	109	4,385	68	423,401	1,373	0	35	879	11,366	97%
48	2017	598,989	16,679	582,310	171	6,590	114	588,534	1,375	536	34	960	14,425	97%
48	2018	618,203	0	618,203	104	3,203	55	605,450	1,373	301	33	971	13,437	97%
48	2019	577,848	0	577,848	93	5,486	93	568,936	1,374	51	34	905	12,220	96%
42	2020	466,825	0	466,825	78	666	12	452,158	1,376	0	35	918	13,094	97%
34	2021	414,166	0	414,166	140	2,047	37	401,371	1,375	0	33	997	12,614	97%
27	2022	374,140	1,186	372,954	144	1,764	27	360,933	1,376	0	33	980	12,753	98%
48	2023	636,726	100,835	535,891	266	7,444	105	626,440	1,374	0	33	972	15,722	98%
48	2024	591,415	45,014	546,401	282	2,002	24	575,759	1,544	52	38	1,017	15,313	97%
2020-2024	Average	496,654	29,407	467,247	182	2,785	41	483,332	1,409	10	34	977	13,899	97%
	Minimum	374,140	0	372,954	78	666	12	360,933	1,374	0	33	918	12,614	96%
	Maximum	636,726	100,835	546,401	282	7,444	105	626,440	1,544	52	38	1,017	15,722	97%
2014-2024	Average	489,044	14,883	474,161	132	3,154	51	476,954	1,390	85	34	941	12,977	97%
	Normal Yr Avg.	604,636	32,506	572,131	183	4,945	78	593,024	1,408	188	34	965	14,223	96%
	Dry Yr Avg.	392,717	198	392,519	89	1,662	29	380,229	1,375	0	34	921	11,938	98%

¹ Calendar year water balance summary. Water year water balance summary is provided in Appendix H.
² Depth of water in inches available equally to each acre of land.
³ Upper Main Canal Efficiency calculated as UMC Inflows to Turlock Lake + UMC Farm Deliveries + UMC Replenishment Deliveries + La Grange Community Delivery divided by sum of all the inflows

Table 5.7. Turlock Lake Water Budget Results, Acre-Feet¹

Available Water (inches) ²	Year	Inflows			Total Releases from Turlock Lake	Outflows					Change in Storage (Lake Level)
		UMC Inflows to Turlock Lake	Turlock Lake Precipitation	Storm Flows (Turlock Lake)		Irrigation Releases from Turlock Lake	Planned Releases from Turlock Lake	Lake Seepage	Lake Evaporation	Change in Storage (Closure)	
20	2014	339,082	1,363	112	322,419	321,975	444	10,478	9,402	-1,742	-9,190
18	2015	304,426	804	48	284,676	284,673	3	9,782	8,888	1,932	1,204
36	2016	423,401	2,110	1,059	385,511	385,493	18	14,409	9,803	16,847	1,982
48	2017	588,534	2,642	2,336	504,790	473,823	30,967	32,842	12,046	43,834	16,765
48	2018	605,450	2,470	700	513,734	513,734	0	40,147	12,950	41,789	2,323
48	2019	568,936	3,194	1,661	484,813	474,018	10,795	39,161	12,432	37,385	1,580
42	2020	452,158	1,060	113	440,788	440,788	0	22,133	10,668	-20,258	-19,548
34	2021	401,371	1,650	381	366,682	366,682	0	14,838	10,756	11,126	5,052
27	2022	360,933	936	418	340,035	336,132	3,903	10,970	9,789	1,493	0
48	2023	626,440	2,750	2,666	583,894	482,341	101,553	27,241	11,365	9,356	-5,200
48	2024	575,759	3,147	453	533,190	492,623	40,567	36,100	12,849	-2,780	14,220
2020-2024	Average	483,332	1,909	806	452,918	423,713	29,205	22,256	11,085	-213	-1,095
	Minimum	360,933	936	113	340,035	336,132	0	10,970	9,789	-20,258	-19,548
	Maximum	626,440	3,147	2,666	583,894	492,623	101,553	36,100	12,849	11,126	14,220
2014-2024	Average	476,954	2,011	904	432,776	415,662	17,114	23,464	10,995	12,635	835
	Normal Yr Avg.	593,024	2,841	1,563	524,084	487,308	36,776	35,098	12,328	25,917	5,938
	Dry Yr Avg.	380,229	1,321	355	356,685	355,957	728	13,768	9,884	1,566	-3,417

¹ Calendar year water balance summary. Water year water balance summary is provided in Appendix H.

² Depth of water in inches available equally to each acre of land.

Table 5.8. TID Distribution System Water Budget Results, Acre-Feet¹

Available Water (inches) ²	Year	Irrigation Season Start Date	Irrigation Season End Date	Number of Days	Inflows										Surface Water Supply Fraction ³	Outflows					Closure	Delivery Fraction ⁵
					Surface Water Supply		Groundwater Supply			Recycled			Precipitation			Canal Operational Spillage	Planned Spillage	Evaporation ⁴	Seepage	Replenishment Deliveries	Deliveries	
					Irrigation Releases	Planned Releases	TID Drainage Pumping	TID Rented Well Pumping	Pump for Credit	Tilewater	Tailwater to Canals	Spill Recovery (Pump 152)	Runoff of Precipitation to Canals	Storm Flows								
20	2014	5-Apr	9-Oct	188	321,975	444	42,845	57,420	14,507	5,642	762	2,294	45	1,963	76%	23,849	444	1,671	43,109	53	378,771	88%
18	2015	4-Apr	13-Oct	193	284,673	3	27,671	35,557	33,596	6,570	797	891	8	200	82%	21,612	3	1,788	37,124	0	329,438	93%
36	2016	3-Apr	6-Nov	218	385,493	18	26,856	52,146	0	8,207	1,053	670	115	2,271	83%	31,579	18	1,421	37,788	25	405,998	86%
48	2017	27-Mar	5-Nov	224	473,823	30,967	23,822	6,597	0	12,106	1,464	1,421	64	6,472	94%	61,127	29,846	1,515	44,816	4,270	415,163	80%
48	2018	23-Feb	17-Nov	268	513,734	0	31,993	8,569	0	8,204	1,432	2,057	52	14,105	93%	78,738	0	1,667	45,032	753	453,957	80%
48	2019	1-Apr	21-Nov	235	474,018	10,795	34,781	6,166	0	7,874	1,342	1,100	75	8,760	92%	84,526	10,795	1,463	36,284	1,688	410,156	78%
42	2020	2-Mar	28-Oct	241	440,788	0	40,489	33,947	0	7,457	1,071	2,128	40	143	86%	59,605	0	1,831	46,014	0	418,612	80%
34	2021	18-Mar	27-Oct	224	366,682	0	32,208	59,544	4,563	5,903	957	1,690	119	2,893	80%	32,404	0	1,746	40,381	0	400,029	86%
27	2022	28-Mar	12-Oct	199	336,132	3,903	31,000	43,683	10,380	4,889	919	1,307	36	756	82%	23,394	2,717	1,936	41,571	0	363,387	87%
48	2023	9-Mar	1-Nov	238	482,341	101,553	24,751	9,459	0	9,737	966	1,949	48	8,189	93%	68,418	99,424	1,480	45,398	4,342	419,931	80%
48	2024	12-Mar	13-Nov	247	492,623	40,567	34,669	6,897	0	8,717	1,154	2,223	25	3,233	92%	68,089	40,406	1,559	47,518	6,234	426,302	78%
2020- 2024	Average				423,713	29,205	32,623	30,706	2,989	7,341	1,013	1,859	54	3,043	87%	50,382	28,509	1,710	44,176	2,115	405,652	82%
	Minimum				336,132	0	24,751	6,897	0	4,889	919	1,307	25	143	80%	23,394	0	1,480	40,381	0	363,387	78%
	Maximum				492,623	101,553	40,489	59,544	10,380	9,737	1,154	2,223	119	8,189	93%	68,418	99,424	1,936	47,518	6,234	426,302	87%
2014- 2024	Average				415,662	17,114	31,917	29,090	5,731	7,755	1,083	1,612	57	4,453	87%	50,304	16,696	1,643	42,276	1,579	401,977	83%
	Normal Yr Avg.				487,308	36,776	30,003	7,538	0	9,328	1,272	1,750	53	8,152	93%	72,180	36,094	1,537	43,810	3,457	425,102	79%
	Dry Yr Avg.				355,957	728	33,512	47,050	10,508	6,445	927	1,497	61	1,371	81%	32,074	530	1,732	40,998	13	382,706	87%

¹ Calendar year water balance summary. Water year water balance summary is provided in Appendix H.

² Depth of water in inches available equally to each acre of land.

³ The Surface Water Supply Fraction is equal to Irrigation Releases from Turlock Lake divided by the sum of all TID Surface Water Supply (Irrigation Releases from Turlock Lake) and all TID Groundwater Supply (Drainage Pumping, Rented Pumping).

⁴ Evaporation is equal to the evaporation from canals minus precipitation that falls on the canal water surface.

⁵ The Delivery Fraction (DF) is equal to Farm Deliveries divided by TID Total Supply (TID Surface Water Supply, TID Groundwater Supply, and TID Other Supply (Tilewater (to Canals), Tailwater (to Canals), Spill Recovery, and Runoff of Precipitation (to Canals))).

Table 5.9. TID Irrigated Lands Water Budget Results¹, Acre-Feet.

Available Water (inches) ²	Year	Applied Water Balance									Precipitation Balance					Net Recharge (af/acre) ⁴	Total Irrigated Area (Acres)	Net Recharge
		Inflows			Outflows				Closure	Crop Consumptive Use Fraction ³	Inflow	Outflows						
		Farm Delivery Treated Waste Water	Private Pumping with Surface	Farm Deliveries	Evapo-transpiration of Applied Water	Tailwater to Canals	Tailwater to River	Tilewater	Deep Percolation of Applied Water		Precipitation	Deep Percolation of Precipitation	Evapo-transpiration of Precipitation	Runoff	Change in Storage			
20	2014	6,607	112,027	378,771	388,154	762	2,395	7,242	98,852	78%	151,647	78,405	56,179	289	16,774	0.06	136,768	8,074
18	2015	7,479	96,822	329,438	387,792	797	2,597	7,933	34,620	89%	76,435	24,478	61,684	59	-9,786	-0.47	135,324	-63,828
36	2016	7,879	65,907	405,998	354,400	1,053	2,884	9,522	111,925	74%	181,824	91,079	96,787	749	-6,791	0.71	134,831	95,883
48	2017	4,939	43,902	415,163	346,880	1,464	2,926	14,190	98,544	75%	159,552	97,904	97,083	356	-35,791	1.24	134,963	166,943
48	2018	5,082	79,738	453,957	377,663	1,432	3,337	9,577	146,768	70%	130,177	59,823	71,660	267	-1,573	0.97	135,269	131,323
48	2019	4,914	47,529	410,156	346,982	1,342	3,867	9,889	100,519	75%	171,654	101,852	100,689	314	-31,201	1.11	135,295	150,179
42	2020	5,138	72,219	418,612	371,332	1,071	3,524	8,342	111,700	75%	68,665	35,083	57,119	177	-23,714	0.34	134,227	46,142
34	2021	4,741	94,724	400,029	412,546	957	3,444	6,800	75,747	83%	130,731	50,897	56,427	540	22,867	-0.15	133,624	-19,451
27	2022	4,266	153,724	363,387	412,326	919	3,270	5,447	99,415	79%	87,227	54,382	49,418	236	-16,809	-0.25	130,279	-33,039
48	2023	4,444	38,334	419,931	321,091	966	2,865	11,316	126,471	69%	161,342	106,315	101,577	305	-46,855	1.59	129,603	205,640
48	2024	4,857	40,714	426,302	302,885	1,154	3,088	9,734	155,012	64%	170,860	94,470	83,652	191	-7,453	1.65	129,902	214,720
2020-2024	Average	4,689	79,943	405,652	364,036	1,013	3,238	8,328	113,669	74%	123,765	68,229	69,639	290	-14,393	0.64	131,527	82,802
	Minimum	4,266	38,334	363,387	302,885	919	2,865	5,447	75,747	64%	68,665	35,083	49,418	177	-46,855	-0.25	129,603	-33,039
	Maximum	5,138	153,724	426,302	412,546	1,154	3,524	11,316	155,012	83%	170,860	106,315	101,577	540	22,867	1.65	134,227	214,720
2014-2024	Average	5,486	76,876	401,977	365,641	1,083	3,109	9,090	105,416	76%	135,465	72,244	75,661	317	-12,757	0.62	133,644	82,053
	Normal Yr Avg.	4,847	50,043	425,102	339,100	1,272	3,217	10,941	125,463	71%	158,717	92,073	90,932	287	-24,575	1.31	133,006	173,761
	Dry Yr Avg.	6,018	99,237	382,706	387,758	927	3,019	7,548	88,710	80%	116,088	55,721	62,936	342	-2,910	0.04	134,176	5,630

¹ Calendar year water balance summary. Water year water balance summary is provided in Appendix H.

² Depth of water in inches available equally to each acre of land.

³ Crop Consumptive Use Fraction (CCUF) is equal to ET of Applied Water divided by Total Irrigation Supply (Farm Deliveries, Private Pumping, and Treated Wastewater).

⁴ Net recharge is calculated as the total groundwater recharge (seepage and deep percolation) minus the total groundwater extraction, divided by the total irrigated area.

Between 2020 and 2024, the surface water supply fraction ranged from 80% to 93% with an average of 87%. Over the 11-year period from 2014 to 2024, the fraction of supply from surface water averaged 93% and 81% in normal and dry years, respectively, with an overall average of 87%. In wet years, the high fraction of surface water demonstrates TID’s conjunctive management of surface water and groundwater to maintain overall supply reliability.

The Delivery Fraction (DF) may also be calculated to compare the total farm deliveries made by TID to meet irrigation demand versus the total supply available to TID, providing an indicator of distribution system performance. The DF is calculated on an annual basis and for the TID distribution system below Turlock Lake according to **Equation 5-3**, by dividing the TID’s total farm deliveries to growers by the total supply available to TID. The total supply includes all surface water, groundwater, and other supplies provided by TID through its distribution system for irrigation purposes, planned releases are excluded from the analysis:

$$DF = (\text{Farm Deliveries}) / (\text{Total Supply} - \text{Planned Releases}) \quad [5-3]$$

For TID, the DF ranged from 78% to 87% between 2020 and 2024, with an average of 82%. The DF over the 2014 to 2024 period averaged 79% and 87% in normal and dry years, respectively, with an overall average of 83%.

Losses from the distribution system at the water supplier scale include spillage, seepage, and evaporation. Of the three loss types, only evaporation losses are non-recoverable. Seepage recharges the underlying groundwater system and spillage is available to downstream water users. Between 2020 and 2024, seepage ranged between 40,000 AF and 48,000 AF with an average of nearly 44,000 AF. Over the 2014 to 2024 period, seepage averaged 44,000 AF in normal years and 41,000 AF in dry years, with an overall average of 42,000 AF. The primary driver of seepage is the irrigation season length, which is generally longer in normal years and shorter in dry years compared to the average season length. TID continually evaluates canal lining condition, maintains canal lining, and relines canals as needed to limit seepage. However, while seepage reduction due to lining increases the available water supply for farm deliveries, it also decreases groundwater recharge benefits to the Turlock Subbasin.

Spillage losses varied from 23,000 AF to 68,000 AF between 2020 and 2024 with an average of 50,000 AF per season. Spillage losses for the 2014 to 2024 period averaged 72,000 AF and 32,000 AF in normal and dry years, respectively, with an overall average of 50,000 AF per year. In dry years, spillage losses have historically been reduced by purposely releasing less surface water from Turlock Lake than needed, and by using wells in the lower reaches of the distribution system to make up the difference. This enables operators to reduce spills by turning pumps on and off to minimize spillage while meeting irrigation demands.

Evaporation losses are relatively small and generally constant over time. Variations from irrigation season to irrigation season result primarily from differences in season length and evaporative demand (i.e., weather) over time. Between 2020 and 2024, evaporation losses varied from 1,500 AF to 1,900 AF, with an average of 1,700 AF in losses per irrigation season. The 2014-2024 averages reflect a similar range.

5.5.4 Irrigated Lands Water Budget

Over the 2020 to 2024 period, TID farm deliveries ranged from approximately 363,000 AF to 426,000 AF and averaged 426,000 AF over each irrigation season. Over the 2014 to 2024 period, farm deliveries averaged approximately 425,000 AF in normal years and 383,000 AF in dry years, with an overall average of 402,000 AF per irrigation season.

As indicated in **Table 5.9**, private pumping ranged from 38,000 AF to 154,000 AF between 2020 and 2024, with an overall average 80,000 AF. Private pumping generally increases in dry years, particularly after multiple consecutive drought years as in 2022. Over the 2014 to 2024 period, private pumping averaged approximately 50,000 AF in normal years and 99,000 AF in dry years, with an overall average of 77,000 AF per irrigation season. As described previously, the reduction in private pumping in dry years demonstrates TID’s conjunctive management of groundwater and surface water.

TID’s conjunctive management strategy provides a reliable District supply in all but the driest years, so that the extra groundwater pumped by growers in dry years is replenished by groundwater recharge, in normal and wetter years. This is confirmed by TID’s net recharge – the total recharge in TID minus the total groundwater extraction in TID during a given year. Across the 2014 to 2024 period, the average annual net recharge in TID was 0.62 AF per gross acre per year.

Recycled water reuse is relatively steady over time due to steady generation of wastewater by the dischargers. Recycled treated wastewater applied directly to TID irrigated lands averaged 5,000 AF over the five-year period of 2020 through 2024. The overall average for the 2014 to 2024 period is 5,500 AF, with little difference between normal and dry years.

The objective of irrigation is to meet crop consumptive demand (ET_{aw}) along with any other agronomic on-farm water needs. Comparing total applied irrigation water to ET_{aw} , a Crop Consumptive Use Fraction (CCUF) may be calculated to provide an indicator of on-farm irrigation performance. The CCUF is calculated on an annual basis by dividing total ET_{aw} by total applied irrigation water according to **Equation 5-4**:

$$CCUF = ET \text{ of Applied Water} / \text{Total Irrigation Supply} \quad [5-4]$$

For TID, the CCUF ranged from 64% to 83%, between 2020 and 2024 with an average of 74%. For the 2014 to 2024 period, the CCUF is lower in normal years, averaging 71% as compared to 80% in dry years. This is attributed in part to lower farm deliveries in drier years and higher effort in using water efficiently, particularly in the driest years.

Losses of applied water from irrigated lands in TID include tailwater (surface drainage that discharges to canals or rivers), tilewater (subsurface drainage through tile drains that discharges to canals or rivers), and deep percolation of applied water. All of the losses are recoverable, as tailwater and tilewater may be used by downstream water users for irrigation or other purposes, and deep percolation of applied water recharges the underlying groundwater system.

Between 2020 and 2024, tailwater discharged to rivers was estimated to be just over 3,000 AF, on average. During the same period, tailwater returning to the distribution system was estimated to average 1,000 AF. Deep percolation of applied water varied from approximately 76,000 AF to 155,000 AF between 2020 and 2024, with an average of 114,000 AF per year.

Over the 2020-2024 calendar years, precipitation inflows to TID ranged between 69,000 AF and 171,000 AF and averaged 124,000 AF per season. Losses of precipitation from irrigated lands in TID include deep percolation of precipitation and runoff of precipitation. Evapotranspiration of precipitation (equivalent to effective precipitation, as described in **Section 5.3.3.1**) occurs both during the winter rainy season and during the irrigation season as some precipitation is also stored within the root zone, particularly during the winter months, and is gradually consumed by crops during early spring. Water year summaries are included in **Appendix H**.

5.6 WATER SUPPLY RELIABILITY

TID requires a firm water supply to meet crop irrigation demands. Almonds, a major crop grown in TID, require a large initial investment and a reliable water supply to establish and maintain economic crop production. Forage crops are also widely grown in TID and are required as a steady food supply for the many dairy herds within the District. TID's water supplies support large areas of permanent crops and crops that could be used to support local animal production, which together span approximately 126,000 acres, or approximately 96% of irrigated land within the TID service area²⁰. This firm irrigation demand drives TID's conjunctive management strategy, which is designed to provide a relatively consistent water supply in all years.

Reliability of water supplies is dependent upon the availability of surface water and groundwater supplies. As discussed in detail in **Sections 3 and 4**, TID's programs and practices have improved water supply reliability through the conjunctive management of surface water and groundwater resources. However, the overall availability of surface water supplies depends on numerous factors, including future hydrology, water rights, and instream flow requirements. Similarly, while Tuolumne River water imported by TID provides the majority of recharge within the Turlock Subbasin, groundwater supplies are relied upon by various irrigation, domestic, industrial and municipal water users within the Subbasin, both within and outside TID boundaries. As a result, the reliability of groundwater resources is dependent upon continued recharge of the Subbasin, and the ability of the various groundwater users to work cooperatively to manage the water supply. TID works with the other agencies within the Turlock Subbasin to facilitate that effort. Although water supply reliability is not within TID's sole discretion, TID will continue to manage the resources available to it, and adjust its programs and practices as needed to provide the most reliable water supplies for its customers today, and into the future.

In addition to the reliability of the supplies themselves, water supply reliability is dependent upon TID's ability to transport the water to where it is used for irrigation. TID owns, operates, and maintains its distribution system, up to and including the sidegate. TID regularly inspects the distribution system, with a focus on identifying and fixing potential problems before they occur. Most of the canal maintenance and system improvements are performed in the non-

²⁰ Combined total of approximately 65,000 acres of permanent orchard and vineyard crops (2020-2024 average), and approximately 61,000 acres of alfalfa, pasture, sudan, corn, unirrigated forage/corn, oats, oats/corn, clover, sorghum, and double-other crops that could be used to support animal production (2020-2024 average). The latter crops are available to support approximately 8,300 acres of confined animal agriculture facilities in TID (Farmland Mapping and Monitoring Program 2020 data for Stanislaus and Merced Counties, California Department of Conservation Division of Land Resource Protection).

irrigation season (typically November through February) to minimize disruption of irrigation deliveries.

Distribution facilities from the canal to irrigated parcels are owned and maintained by individual growers or groups of growers who have formed IDs. TID assists IDs in maintaining the facilities and recovers the costs from the growers. Administering IDs in this way enables quick responses when maintenance issues arise and improves system reliability by reducing the downtime associated with repairs.

Specific programs and planning efforts that will have a significant impact on the future availability and reliability of water supplies are described below.

5.6.1 Bay-Delta Plan and FERC Relicensing of Don Pedro Reservoir

The State Water Board is responsible for adopting and updating the Water Quality Control Plan for the San Francisco Bay/Sacramento–San Joaquin Delta Estuary (Bay-Delta Plan), which establishes water quality control measures and flow requirements needed to provide reasonable protection of beneficial uses in the watershed.

On December 12, 2018, the State Water Board adopted an update to the Bay-Delta Plan, which established Lower San Joaquin River flow objectives and revised southern Delta salinity objectives. These initial amendments to the Plan (“Phase 1”) apply to three tributaries to the San Joaquin River: the Merced, Tuolumne, and Stanislaus Rivers.

The new flow objectives for the Tuolumne would require MID and TID to release 40 percent of unimpaired flows into the Tuolumne River from February 1 to June 30 for salmon and salinity control in the Delta.

The impacts of Phase 1 of the Bay-Delta Plan on TID and its growers are significant. Water available for diversion for farmland irrigation and municipal supply will be reduced in all water year types, but reductions will be most severe during drier years. In its 2016 comments to the State Water Board on the Bay-Delta Plan, TID noted that the 40 percent unimpaired flow scenario would increase the frequency and severity of water supply shortages to its growers.

In adopting the amendments to the Bay-Delta Plan, the State Water Board (SWB) agreed to support efforts by the Department of Water Resources (DWR) to negotiate a Delta watershed-wide agreement, including potential flow and non-flow measures for the Tuolumne River, as an alternative to the Bay-Delta Plan update. This Voluntary Agreement (VA) process would grant the Tuolumne River some relief from the unimpaired flow requirements of the Bay-Delta Plan. Throughout 2019 and 2020, TID staff were in discussions with various State agencies regarding flow and non-flow measures that could be incorporated into a VA. Since 2019, TID and its partners on the Tuolumne have been in discussions with DWR and SWB on the Tuolumne VA. In November 2022, TID signed a statewide Memorandum of Understanding advancing a term sheet for the Tuolumne VA. Since that time, TID has been working with Public Water Agencies on finalizing the package of VA flow and non-flow measures for analysis by the SWB. In October of 2025, the SWB released the Draft Scientific Basis Report (SBR) for the Tuolumne Voluntary Agreement and public comments were received in writing and at a workshop on November 5, 2025. The draft SBR is subject to peer review; thereafter, the Tuolumne VA must undergo review pursuant to the California Environmental Quality Act. Given these procedural

requirements under state law, the SWB could consider the Tuolumne as early as late 2026 or early 2027.

Concurrent with this VA effort is the Federal FERC relicensing of Don Pedro Reservoir. Under the Federal Power Act, the State Water Board is authorized to issue a Water Quality Certification under Section 401 of the Clean Water Act to address the water quality impacts of the Don Pedro project. The Water Quality Certification also provides the State Water Board with the opportunity to implement the Bay-Delta Plan's unimpaired flow regime on the Districts.

The new flow objectives under the Bay-Delta Plan will affect the future reliability of water supplies, potentially significantly reducing the volume of water available for diversion by TID and reducing the water supply available to growers. While a VA will still require the District to release more water to the Tuolumne for ecosystem benefits, a VA offers the District the best opportunity to mitigate the impacts of the Bay-Delta Plan on its growers.

5.6.2 Sustainable Groundwater Management Act and Groundwater Sustainability Plan

The Sustainable Groundwater Management Act of 2014 (SGMA) provides for local control of groundwater resources while requiring sustainable management of these resources. Specifically, SGMA requires groundwater subbasins to establish governance by forming local Groundwater Sustainability Agencies (GSAs) with the authority to develop, adopt, and implement a Groundwater Sustainability Plan (GSP). Under the GSP, GSAs must adequately define and monitor groundwater conditions in the subbasin and establish criteria to maintain or achieve sustainable groundwater management within 20 years of GSP adoption.

Agencies within the Turlock Subbasin have formed two GSAs to comply with SGMA. The West Turlock Subbasin GSA (WTSGSA) includes the area within the TID's irrigation boundaries. TID is an active member of the WTSGSA, with staff helping to facilitate GSA activities. The East Turlock Subbasin GSA (ETSGSA) generally covers the area to the east of the WTSGSA. The GSAs have a Memorandum of Agreement that outlines the process by which the GSAs are working together to ensure the Subbasin is in compliance with SGMA. Both GSAs have been actively engaged in developing and implementing a single GSP for the Subbasin. The GSP was submitted to the Department of Water Resources (DWR) in January 2022, and in January 2024, was determined by DWR to be incomplete. The GSAs addressed the deficiencies and corrective actions identified by DWR and submitted a Revised GSP in July 2024. The 2024 Revised GSP was approved by the DWR in February 2025.

In accordance with SGMA, the WTSGSA and the ETSGSA must work together to achieve sustainable groundwater use in the Turlock Subbasin by 2042. Although TID has effectively implemented conjunctive management of groundwater and surface water supplies, groundwater is not an unlimited supply. TID is working with the GSAs to achieve groundwater sustainability in the Turlock Subbasin, while maintaining the future availability and reliability of TID water supplies, by increasing conjunctive management through projects to recharge water available in wet years.

5.7 WATER MANAGEMENT OBJECTIVES

Since its formation as the first irrigation district in California, TID has been driven by its mission to provide reliable and affordable irrigation water and electric service, while being a good steward of local water resources and providing high levels of customer satisfaction.

- **Conjunctive Management.** As described in **Section 4.1.2.2**, TID practices conjunctive management of surface water and groundwater, coordinating the operation and monitoring of surface water and groundwater supplies to provide reliable water supplies for its customers. Groundwater recharge of high quality, low TDS surface water from Don Pedro Reservoir benefits groundwater supply availability in dry years and helps to improve groundwater quality. TID has initiated active recharge programs such as the Dianne Storm Basin, the TID On-Farm Recharge Project, and the Agricultural Recharge Project. TID, as a member of the West Turlock Subbasin Groundwater Sustainability Agency (WTSGSA), adopted and began implementing the Turlock Subbasin Groundwater Sustainability Plan (GSP) in 2022. The GSP identifies actions needed to achieve groundwater sustainability in the Turlock Subbasin, providing support for ongoing conjunctive use of surface water and groundwater supplies in the Subbasin.
- **Affordable, Tiered Pricing Structure.** As described in **Section 2.2.3**, TID offers water on two rate schedules, one for normal (or wetter) years and one for dry years, encouraging different water use practices between water year types. In normal and wetter years, lower pricing of surface water encourages growers to maximize their use of available surface water and allows for in-lieu recharge. In dry years, higher pricing encourages conservation of limited surface water supplies and provides additional revenue to recover increased pumping costs. Even in dry years, surface water is priced affordably compared to private groundwater pumping. An important aspect of TID's conjunctive management strategy includes setting the price of TID water appropriately in all years to discourage growers from becoming permanently reliant on groundwater. The volumetric rate structure was updated in 2025 and has been in effect since the start of the 2025 irrigation season, as described in **Section 2** of this AWMP. This structure is designed to continue to support the District's critically important conjunctive management objectives, while also complying with the requirements of SBx7-7.
- **Available Water Policies.** As described in **Section 2.2.4**, TID's Board of Directors determines the amount of water available to customers each year, with the goal of meeting and exceeding customer expectations while also balancing near-term and long-term water supply availability. The Board makes two key decisions: whether to use the normal or dry year rate schedule, and the amount of water available on a per acre basis. These decisions are based on projected runoff, including the possibility of the occurrence of consecutive dry years, carryover storage, flows required to be delivered to the lower Tuolumne River, and the availability of rented pumps.
- **Operational Efficiency Improvements.** TID has long been proactive in improving the operational efficiency of its distribution system. Key efforts include automation, monitoring, infrastructure improvements, and WDO training. TID began installing a Supervisory Control and Data Acquisition (SCADA) system in 1997, with data collection beginning in 1998. Today, TID collects water measurement data from 493 SCADA sites,

including nine miles of Rubicon Total Channel Control (TCC) automation and remote drainage pump controls. These improvements have resulted in more accurate flows throughout TID's service area and have enhanced the ability of WDOs to carefully and strategically operate canals to meet and exceed evolving customer expectations.

In 2019, TID completed a multi-year planning effort that culminated in the TID Irrigation Facilities Master Plan (IFMP). The IFMP evaluated existing service levels in TID and then identified a comprehensive list of projects to strategically and cost-effectively rehabilitate and modernize TID irrigation facilities with the goal of maintaining and improving the level of irrigation service provided to its growers. In 2019, TID also completed its Irrigation Delivery Operations Assessment that evaluated TID operational efficiency through comparison of efficiency indicators with other irrigation water suppliers in California, and through observation and interviews with WDOs. The assessment identified opportunities to improve efficiency through increased modernization of District software, strategic SCADA monitoring, and expanded training for District WDOs and other field staff.

- **Capital Improvements for On-Farm Irrigation Systems:** The Turlock Subbasin GSP includes projects that facilitate on-farm improvements that encourage continued use of surface water (On-Farm Recharge Project (in WTSGSA)). TID continually searches for grants on behalf of the District and its customers, including those to support on-farm improvements. TID will continue to identify and evaluate opportunities to facilitate financial assistance for on-farm capital improvements.
- **Construction of Regulating Reservoirs:** TID has actively pursued the construction and evaluation of regulating reservoirs to improve water distribution efficiency and reduce operational spillage. Key efforts include the construction and expansion of the Lateral 8 Regulating Reservoir, evaluation of reservoir sites on the Ceres Main Canal, and development of the IFMP, which outlines over 50 modernization projects. These projects aim to enhance canal conveyance, support on-farm irrigation efficiency, and increase water conservation. TID has completed construction of the Ceres Main Canal Reservoir, finalized the design for the Lateral 5 ½ Reservoir, and obtained CEQA clearance for its construction.
- **Increased Flexibility to Water Users:** TID continues to offer arranged-frequency demand deliveries and enhancing customer service tools. In 2024, TID introduced an earliest delivery date option, reducing wait times to 18-24 hours compared to 44-48 hours for all orders. TID has expanded online ordering, real-time water use tracking, and SCADA-based monitoring to support flexible deliveries, including non-standard flows for micro-irrigation systems. Infrastructure improvements such as the Lateral 8 and Ceres Main regulating reservoirs have increased operational flexibility. TID also allows groundwater contributions with delivery credits in dry years. Ongoing planning through the IFMP will guide future modernization projects aimed at further improving delivery flexibility and system performance.
- **Evaluating Supplier Policies:** TID has ongoing partnership with cooperating entities at Don Pedro Reservoir, including participation in watershed studies and programs such as Forecast-Coordinated Operations (F-CO), Forecast-Informed Reservoir Operations (FIRO), and the Airborne Remote Sensing for Snowpack (ARSS) Program. These efforts

enhance TID’s ability to manage flood and water supply storage more effectively. TID also coordinates with regulatory agencies to navigate policies affecting water storage and delivery flexibility. As a member of the WTSGSA, TID remains actively involved in SGMA implementation and GSP implementation and will continue to evaluate and pursue locally cost-effective opportunities to improve delivery and storage flexibility in coordination with other agencies in the Subbasin.

5.8 WATER USE EFFICIENCY

Water use efficiency is a core consideration in TID’s operations. As stated above, TID’s mission is to be a good steward of its water resources while also providing high levels of customer satisfaction. Efficient water use at all levels benefits this mission by conserving or utilizing water for maximal benefit to TID’s customers and downstream water users.

Key water use components and water use efficiency in TID are quantified in the sections below.

5.8.1 Water Use Efficiency Components

Four types of water use serve as the basis for water use efficiency calculations: crop water use, agronomic water use, environmental water use, and recoverable flows. These water use efficiency components are quantified in **Table 5.10** and described in the sections below.

5.8.1.1 Crop Water Use

Crop water use, or crop consumptive use, in TID represents the portion of total applied water withdrawn by crops that is evaporated, transpired, incorporated into products or crops, or otherwise removed from the immediate water environment for consumptive use (ASCE, 2016).

In the water budget presented in this AWWMP, crop water use of applied water is represented by evapotranspiration of applied water (ET_{aw}). ET_{aw} is quantified as an outflow of the IDC root zone water budget described in **Section 5.3.3**. **Table 5.10** summarizes the ET_{aw} in TID in 2020 through 2024.

5.8.1.2 Agronomic Water Use

Agronomic water use in TID represents the portion of total applied water that is directly used for crop cultivation practices, but that is not consumed by crops (i.e., excluding ET_{aw}). Sample agronomic water uses include soil leaching, seedbed preparation, and climate control. In TID, agronomic water uses mainly include pre-irrigation of corn for germination, and additional small water volumes used for salt leaching and frost protection.

Table 5.10. Water Use Efficiency Components.

Water Use Efficiency Component	Year (Year Type ¹ , Available Water ²)					
	2020	2021	2022	2023	2024	Average
	(D, 42")	(D, 34")	(D, 27")	(N, 48")	(N, 48")	
Crop Consumptive Use (ET_{aw})	371,332	412,546	412,326	321,091	302,885	364,036
Agronomic Use ³	8,282	5,752	15,901	4,816	5,249	8,000
Environmental Use ⁴	0	0	0	0	0	0

SECTION FIVE

WATER ACCOUNTING AND WATER SUPPLY RELIABILITY

Water Use Efficiency Component	Year (Year Type ¹ , Available Water ²)					
	2020	2021	2022	2023	2024	Average
	(D, 42’')	(D, 34’)	(D, 27’)	(N, 48’)	(N, 48’)	
Recoverable Flows of Applied Water						
Recoverable Flows to Groundwater (DP _{aw})	111,700	75,747	99,415	126,471	155,012	113,669
Recoverable Surface Flows (Tailwater to Rivers, Tilewater to Rivers)	4,409	4,341	3,828	4,444	4,105	4,225
Total Recoverable Flows of Applied Water	116,109	80,088	103,243	130,915	159,117	117,894
Recoverable Flows of Total Water Supply						
Recoverable Flows to Groundwater (DP _{aw} , Seepage)	192,941	143,580	164,709	214,832	253,943	194,001
Recoverable Surface Flows (Spillage, Tailwater to Rivers, Tilewater to Rivers)	64,014	36,745	27,222	72,862	72,194	54,607
Total Recoverable Flows of Total Water Supply	256,955	180,325	191,931	287,694	326,137	248,608

¹ Year types, as determined by the TID Board of Directors, are normal (N) or dry (D).

² The amount of water available for purchase by irrigators in TID, in inches per acre per season.

³ Assuming pre-irrigation of corn, frost protection, and leaching requirements for crops served along laterals with higher TDS (average >500 ppm more than one year).

⁴ Assuming negligible environmental use within TID service area (Tuolumne River instream flow requirements are met before irrigation releases and considered to be outside the TID service area).

Agronomic water use for pre-irrigation of corn was estimated based primarily on data used in the water budget. First, using TID delivery data, the irrigation volume delivered during the first delivery (assumed to be a pre-irrigation) was reviewed for each corn field in TID during each season. The ET_{aw} that occurred between the first and second irrigations to the same parcel in the same year was subtracted from the first irrigation volume, so as not to double-count ET_{aw} from pre-irrigation as both an “agronomic water use” and a “crop consumptive water use”. On average, this analysis found that approximately 4 inches of water was delivered during the first irrigation and approximately 2 inches of water was consumed as ET_{aw} between the first and second irrigation resulting in an estimate of 2 inches of water used for agronomic purposes. It was assumed that 2 inches was applied for agronomic use, on average, to all fields identified as “corn” in all years. In normal years, it was assumed that 2 inches was also applied to all fields in which unirrigated forage was grown before corn (“unirrigated forage/corn”), while in dry years, it was assumed that 2 inches was applied to only 50% of all fields identified as “unirrigated forage/corn.”

Surface water released from Turlock Lake is very high quality, with low salinity and low TDS, resulting in generally low leaching requirements for the crops grown in the District. However, the salinity of groundwater and drainage in TID is markedly higher, increasing the TDS of water in canals downstream of where these supplies are mixed. To estimate the agronomic water use from leaching, a reach-by-reach water quality model was used. This model was developed to support the aforementioned draft IFMP and calculates the mass balance of TDS in each reach based on the TDS concentration and volume of all inflows to that reach. Following recommended water management practices per FAO Irrigation Water Management: Training Manual No. 1 (Brouwer et al., 1985), leaching was estimated for all parcels along or downstream of reaches in which the water quality model average TDS exceeded 500 ppm in more than one

irrigation season. Considering all crop types served along each lateral, weighted by the volume of water delivered to each crop type, an average required leaching fraction of 5% was calculated for these parcels.²¹

Agronomic water use for frost protection was estimated assuming a typical, average required frost protection application rate of 0.15 inches per hour for cold-sensitive crops on days when the minimum, average, or maximum temperature was below 32°F (assuming 12, 18, or 24 hours of potential frost protection is needed, based on which temperature, respectively, was below 32°F). Crops requiring potential frost protection were assumed to vary by month, with citrus and vineyard requiring frost protection in November through January, and with citrus, vineyards, and early blooming orchards (e.g., apricots, cherries, peaches, pears, plums) requiring frost protection in February through March. The total volume of potential frost protection was then adjusted so as not to exceed the monthly applied water used by irrigators from private pumping.

Table 5.10 summarizes these total combined agronomic water uses in TID.

5.8.1.3 Environmental Water Use

As described in **Section 3.2**, there are no natural environmental resource delineations within the irrigation service area that are supported by TID diversions.

While the Federal Energy Regulatory Commission (FERC) license requirements for Don Pedro Reservoir include an extensive set of minimum instream flow release requirements, these instream requirements are met before irrigation diversions are made. Releases to the Tuolumne River for environmental purposes therefore reduce the remaining supplies available for irrigation, and are not met from TID's irrigation water supplies.

During the non-irrigation season of certain wetter years, TID has released water from Don Pedro Reservoir through the TID distribution system to prevent flooding of the Tuolumne River downstream of Don Pedro Reservoir and to maintain sufficient storage capacity in the reservoir for flood flows. TID allows irrigators to utilize this water and apply it to fields for recharge, while also providing some spillage to the Tuolumne, Merced, and San Joaquin rivers. While these uses provide potential environmental benefits to the Turlock Subbasin and the Tuolumne, Merced, and San Joaquin rivers, they are accounted as recoverable flows for the purposes of this AWMP.

5.8.1.4 Recoverable Flows

Recoverable flows in TID encompass the portion of total applied water, or total water supply, that are neither consumed by crops nor evaporated from the distribution system, but that are recoverable for other beneficial uses within TID, downstream of TID, or in other areas overlying the Turlock Subbasin. Recoverable flows of applied water are represented in this water budget by deep percolation of applied water (DP_{aw}), as well as tailwater and tilewater drainage to rivers

²¹ Average crop-specific leaching requirements are estimated to be approximately equal to the requirements given in CIMIS Drought Tips Report #92-16 for $EC_i = 0.5$ dS/m, recognizing that the salinity of irrigation water is not always in excess of 500 ppm TDS.

outside the TID service area. As described in **Section 5.3.3**, DP_{aw} is quantified as the closure term of the irrigated lands accounting center in TID’s water budget.

Of the total water supplies available to TID, recoverable surface flows include spillage from the TID distribution system, which is measured by TID’s network of SCADA sites. Recoverable flows to groundwater include seepage (**Section 5.3.1.5**).

Table 5.10 summarizes the combined recoverable flows from TID in 2020 through 2024.

5.8.2 Water Use Efficiency Fraction

The water use efficiency fraction most applicable to TID is the water management fraction (WMF). As depicted in **Figure 5.1**, there is extensive interconnection between the accounting centers due, in part, to recapture and reuse of water by TID. Conjunctive management efforts by TID also promote the sustainable recharge of groundwater in wetter years and recovery in drier years. Some reuse also occurs directly by water users at the farm level, while other users outside of TID are also able to recover surface water and groundwater made available from spillage and seepage of TID water supplies. These methods of water recovery, recharge, and reuse result in higher levels of system performance and water use efficiency than would otherwise occur.

The water management fraction (WMF) can be calculated in two ways: (1) by comparing consumptive use of applied water (ET_{aw}) and the recoverable flows of applied water to the total applied water in TID, and (2) by comparing consumptive use of applied water and all recoverable flows in the TID distribution system and irrigated lands to the total water supplies available within TID. The WMF is calculated on an annual basis at the water supplier scale according to

Equation 5-5:

Total Water Supply Basis: $WMF = (ET_{aw} + DP_{aw} + \text{Tailwater to Rivers} + \text{Tilewater to Rivers} + \text{Canal Spillage} + \text{Seepage} + \text{Change in Lake Storage}) / (\text{Total Water Supply})^{22}$ [5-5]

Over the 2020 to 2024 calendar years, the WMF varied from 98 to 99 percent (**Table 5.11**). This high WMF indicates that essentially all of TID’s water supply is used to meet irrigation demands or is recoverable for beneficial use by downgradient surface water and groundwater users. The only water budget flow path that is not recoverable or consumed by crops in TID is evaporation from the TID distribution system.

Table 5.11. Water Use Efficiency Fraction (Total Water Supply Basis), Acre-Feet.

Year ¹	Evapotranspiration of Applied Water	Recoverable Flows of Total Water Supply ²	Total Water Supply ³	Water Management Fraction
2020	371,332	256,955	638,399	98%
2021	412,546	180,325	602,770	98%
2022	412,326	191,931	616,070	98%
2023	321,091	287,694	616,178	99%

²² Total water supply is equal to the sum of Irrigation Releases from La Grange Diversion Dam, Annual change in Turlock Lake Storage, Drainage Pumping, Rented Pumping, Tilewater (to Canals), Tailwater (to Canals), Spill Recovery, Treated Wastewater, and Private Pumping.

SECTION FIVE

WATER ACCOUNTING AND WATER SUPPLY RELIABILITY

Year ¹	Evapotranspiration of Applied Water	Recoverable Flows of Total Water Supply ²	Total Water Supply ³	Water Management Fraction
2024	302,885	326,137	634,162	99%
Avg 2020-2024	364,036	248,608	621,516	99%

¹ Reported for calendar year, as TID generally only operates the distribution system to supply irrigation deliveries during the irrigation season.

² Recoverable flows of total water supply include DP_{aw} , Seepage, Canal Spillage, Tailwater (to Rivers) and Tilewater (to Rivers).

³ Total water supply includes Irrigation Releases from La Grange Diversion Dam, Annual Change in Turlock Lake Storage, Drainage Pumping, Rented Pumping, Tilewater (to Canals), Tailwater (to Canals), Spill Recovery, Private Pumping, and Treated Wastewater.

6. Climate Change

6.1 INTRODUCTION

In recent years, the District has experienced record breaking droughts, floods, and temperature periods compared with the last 100-year record. The District has taken these experiences and developed an evolving suite of tools and adaptation techniques to manage its water resources. The District is committed to adapting to climate change in a manner that continues to maximize water supply reliability for TID customers through conjunctive management, while satisfying Tuolumne River instream flow obligations. These tools and techniques developed to address past changes will be invaluable as we study and experience additional changes in climate and impacts to water resources in the future. Some of these tools include:

- Airborne Remote Sensing for Snowpack Program
- Forecast-Informed Reservoir Operations (FIRO) Program, with support from the Forecast-Coordinated Operations (F-CO) for the San Joaquin River watershed
- Real-Time Hydrologic Modeling of the Tuolumne River Watershed, in partnership with Hydrocomp
- Tuolumne Climate Change HFAM Modeling Report (January 2026)
- Tuolumne Watershed Study Area Report (December 2025), California Department of Water Resources
- Weather Resources Management Program
- Weather Generator Model
- Sustainable Groundwater Management Planning
- Tuolumne River Management Planning
- Data management with KISTERS

Most recently, TID commissioned Hydrocomp, Inc. to prepare the “Tuolumne Climate Change HFAM Modeling Report.” The report used the existing HFAM model and the HFAM Systematic Operations Analysis for Reservoirs (SOAR) tool to model the impacts of potential changes in meteorology. This modeling work incorporated the use of the Cornell Weather Generator to represent a range of climate change scenarios. The report found that recent temperature trends have already reduced the reliability of TID’s irrigation deliveries.

According to Hydrocomp (2026), under climate change, average precipitation in the Tuolumne watershed is expected to experience significant shifts in variability and intensity. Due to thermodynamic changes (temperature-driven), three major shifts are expected to occur: storms are expected to be more intense, storms will be more variable (wetter wet years and drier dry years), and more precipitation will fall as rain rather than as snow.

These programs and planning efforts are described in further detail in **Section 6.5**, “Strategies to Mitigate Climate Change Impacts.” The near-term benefits of these programs dovetail with TID’s evolving need to prepare for and respond to the effects of climate change on water supply and demand. In the face of future climate uncertainty, TID’s leadership in these efforts is now more important than ever.

Over its history, TID has also completed numerous other programs and projects, and enacted policies to enhance the reliability and efficient management of its water resources. **Section 7** of this AWMP describes TID's efficient water management practices and related efforts in recent years.

Section 6 discusses the potential effects of climate change on the District and its water supply and water demand. Finally, this section identifies actions currently underway that support climate change preparedness, and actions that could be implemented to help mitigate future impacts of climate change.

6.2 POTENTIAL CLIMATE CHANGE EFFECTS

TID has long recognized the effects of climate change on water supply and demand, including reduced winter snowpack, more variable and extreme weather conditions, shorter winters, and increased evaporative demand. Additionally, climate change could affect water quality through increased flooding and erosion; greater concentration of contaminants, if any, in the water supply; and warmer water, which could lead to increased growth of algae and other aquatic plants. Rising sea level and increased risks of flooding are also potential effects of climate change.

The discussion of potential climate change effects in this AWMP focuses on the potential effects related to TID's water supply and demand. Potential effects of rising sea level or increased flooding risks are not discussed except in the context of reduced firm yield. TID is not located within or adjacent to the Sacramento-San Joaquin River Delta and is not expected to be directly impacted by rising sea level. TID is also required to follow the flood management criteria established by the Army Corps of Engineers at Don Pedro Reservoir. While the District conveys some stormwater for communities in adjacent urban areas, TID's distribution system and facilities merely provide conveyance to the river system. Stormwater management is the responsibility of the communities.

6.2.1 Sources of Information Describing Potential Climate Change Effects

Potential climate change effects are evaluated based on existing historical data and projections of future hydrology and climate parameters, such as temperature and precipitation. The information sources used to quantify these historical values, and projected effects are described below.

6.2.1.1 Hydrology

In this AWMP, the potential impacts of climate change on TID water supplies are evaluated using historical data for full natural flow (unimpaired runoff) in the Tuolumne River below La Grange, along with projected changes to Tuolumne River hydrology over the next 50 years.

Historical full natural flows along the Tuolumne River are reported by DWR's California Cooperative Snow Surveys, available through the California Data Exchange Center²³.

²³ <https://cdec.water.ca.gov/webgis/?appid=cdecstation&sta=TLG>

Projected changes to Tuolumne River flows are derived from the Central Valley Flood Protection Planning (CVFPP) 2022 Update²⁴ where a historical climate and three future climate scenarios were considered. The Coupled Model Intercomparison Project Phase 5 (CMIP5) future climate scenarios used in the CVFPP 2022 Update include 32 Global Circulation Models (GCMs) under two Representative Concentration Pathways (RCP 4.5 and 8.5). The climate projections from the global models were downscaled to ~6km using the locally constructed analogs (LOCA) statistical downscaling method.

The CVFPP Update evaluated changes in Tuolumne hydrology using the Variable Infiltration Capacity (VIC) model. VIC is a macro-scale, semi-distributed hydrologic model that simulates water and energy balances across predefined grid cells. It provides key outputs relevant to this analysis, including daily estimates of river flow, reference evapotranspiration, and soil moisture—critical variables for assessing climate-driven changes in water availability and demand. The results have been summarized as part of this section, with additional details in **Section 6.2.2**.

The LOCA dataset used in the 2022 CVFPP Update include:

- *No Climate Change*: The historically observed climate.
- *Medium scenario*: derived from downscaled CMIP5 Climate Models falling within the inner quartile (25th to 75th percentile) of precipitation and Temperature Projections.
- *Hotter-Wetter Scenario (High)*: derived from 10 model-RCPs sample closest to the maximum projected Precipitation and Temperatures changes.
- *Warmer-Drier Scenario (Low)*: derived from 10 model-RCPs sample closest to the minimum projected Precipitation and Temperatures changes.

6.2.1.2 Climate Parameters

The potential impacts of climate change on crop water demand in TID are evaluated using historical data for precipitation, temperature, and ET_o in and around TID.

Historical precipitation data are reported by the National Oceanic and Atmospheric Administration (NOAA) weather station #49073 “Turlock Number 2” for the period 1927²⁵-present. Historical temperature and ET_o data in an agricultural setting are reported by the Modesto CIMIS station²⁶ (#71; 1987-present), located in the vicinity of TID. The Denair CIMIS station (#168; 2003 - April 2009), and the Denair II CIMIS station (#206; April 2009 - 2025) also report historical temperature and ET_o data in an agricultural setting within the TID service area, but with shorter periods of record. To prevent differences in station locations from obscuring changes in temperature and ET_o over time, only the Modesto CIMIS station is evaluated in this section.

²⁴ <https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Flood-Management/Flood-Planning-and-Studies/Central-Valley-Flood-Protection-Plan/Files/CVFPP-Updates/2022/FINAL-2022-CVFPP-Technical-Analysis-Summary-Report.pdf>

²⁵ Incomplete precipitation data from NOAA weather station #49073 are available at beginning in 1893, though the generally complete data record begins in 1927. Montly precipitation data is available here: <https://wrcc.dri.edu/cgi-bin/cliMAIN.pl?ca9073>

²⁶ <https://cimis.water.ca.gov/WSNReportCriteria.aspx>

Potential effects of climate change on crop evapotranspiration (ET) are evaluated based on results from the VIC model results and observed crop ET.

6.2.2 Summary of Potential Climate Change Effects

6.2.2.1 Changes in Timing of Runoff

6.2.2.1.1 Historical Runoff

Based on available historical data and projected future streamflow, the amount of annual runoff occurring during the spring-summer period from April through July has decreased over the past century and will likely continue to decrease in the next century.

From 1901 to 2024, unimpaired flow (i.e., full natural flow) along the Tuolumne River below La Grange shows a decreasing trend in April to July runoff as a percentage of total water year runoff (**Figure 6.1**). Conversely, increasingly more runoff has occurred during the fall-winter period, outside of the irrigation season.

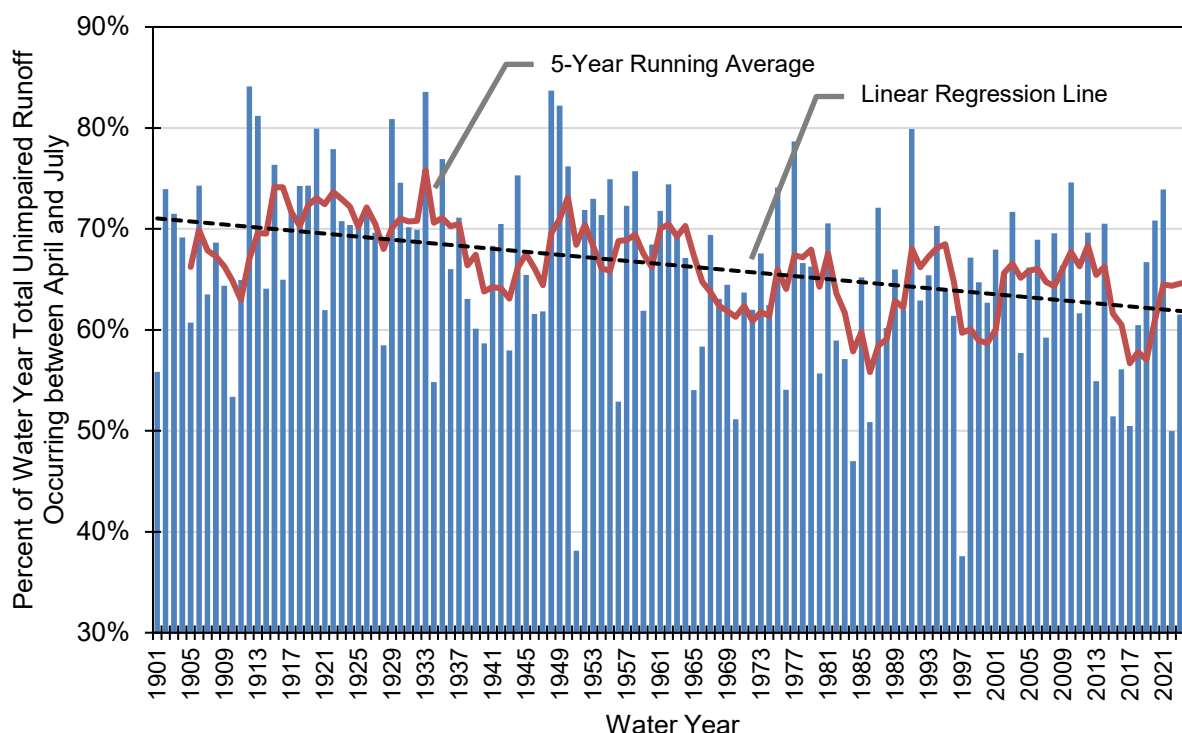


Figure 6.1. Unimpaired Runoff for Tuolumne River below La Grange, April-July Runoff as a Percent of Total Water Year Runoff.

6.2.2.1.2 Projected Runoff

The monthly runoff for the historical climate (1915-2011) and three future climate scenarios at Tuolumne River Below Dry Creek are shown in **Figure 6.2**. Future Spring-Summer runoff significantly decreases under all climate scenarios, shifting towards winter and fall seasons. The largest shift from snow-melt season to rain season occurs in the Hotter-Wetter scenario.

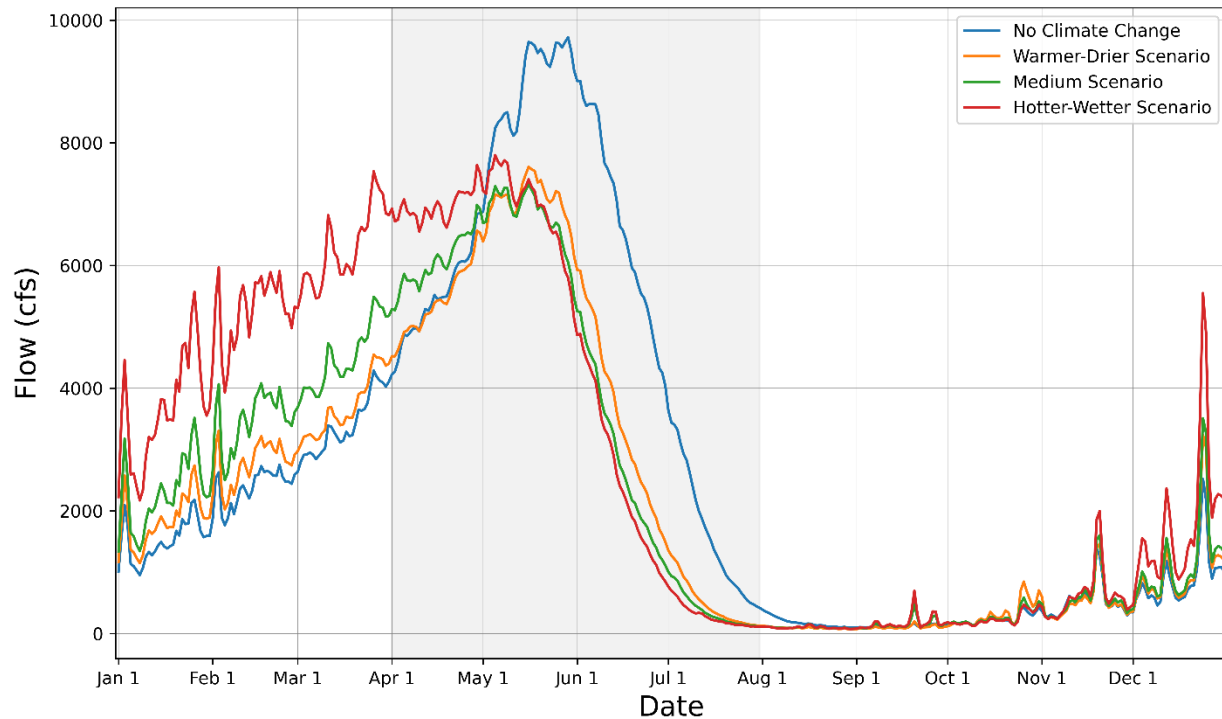


Figure 6.2. Unimpaired Runoff for historical (no climate change) and three future climate scenarios for Tuolumne River below Dry Creek (CVFPP 2022 Update).

6.2.2.2 Changes in Total Runoff

The percentage of total runoff occurring during the April-July period is also expected to continue to decline over the next century. The CVFPP 2022 Update simulations using the three future climate scenarios in 2072 indicate that the annual unimpaired runoff volume decreases from 71% during the baseline period to 62%, 57% and 49% for Warmer-Drier, Medium and Hotter-Wetter scenarios respectively (**Figure 6.3**).

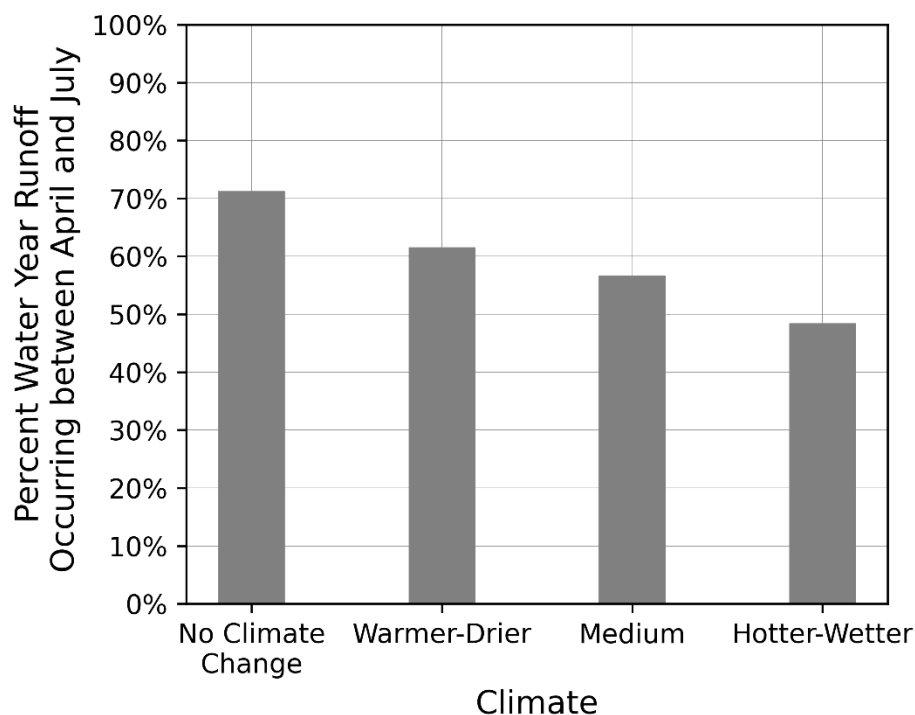


Figure 6.3. Percentage of the April-July runoff in Tuolumne River Runoff below Dry Creek for Different Climate Scenarios (Source: CVFPP Update 2022).

6.2.2.3 Changes in Climate Parameters and Crop Evapotranspiration

Climate change has the potential to affect crop evapotranspiration and resulting irrigation water demands within TID. Changes in precipitation, temperature, and atmospheric CO₂ each affect crop evapotranspiration (ET) and net irrigation water requirements (NIWR).

Historical precipitation, air temperature, and reference ET (ET_o) are first summarized to provide context for the projected changes in climate parameters due to climate change. Precipitation records in TID, including annual precipitation, mean annual precipitation, and cumulative departure²⁷ from the mean annual precipitation, are shown in **Figure 6.4**. Between water years 1927 and 2024, the mean annual precipitation was approximately 12 inches per year in TID. As shown, wet periods (indicated by a positive slope in the cumulative departure from mean curve) have historically occurred over a shorter duration within TID than drier periods (indicated by a negative slope in the cumulative departure from mean curve), even since the 1930s and 1940s. Notable drought periods, including 1976-1977, 1987-1992, 2012-2016, and 2020-2022 are seen as generally falling at the end of extended drier periods, ending with the beginning of a significantly wetter period.

²⁷ Cumulative departure curves are useful to illustrate long-term hydrologic characteristics and trends during drier or wetter periods relative to the mean annual precipitation or streamflow. Downward slopes of the cumulative departure curve represent drier periods relative to the mean, while upward slopes represent wetter periods relative to the mean. A steep slope indicates a drastic change in dryness or wetness during that period, whereas a flat slope indicates average conditions during that period, regardless of whether the total cumulative departure falls above or below zero.

Figure 6.5 shows the mean daily temperatures at the Modesto CIMIS station near TID. CIMIS stations are specially sited within agricultural areas to provide climate parameters that are most representative of the conditions experienced by irrigated agriculture. Between water years 1988 and 2024, the average daily air temperatures in TID have averaged approximately 59°F, while the maximum and minimum daily temperatures have averaged 73°F and 45°F, respectively.

Although temperatures vary from year to year at the Modesto CIMIS station, average air temperatures have slightly increased in the last 10 years compared to earlier averages. Between water years 1988 and 1997 – the first 10 complete years of available data at the Modesto CIMIS station – average air temperatures were 58.5 °F. Between water years 2015 and 2024 – the most recent 10 years of available data – average temperatures increased by about two degrees, with an average daily air temperature of approximately 60.5°F, and with maximum and minimum daily temperatures averaging 75.4°F and 46.5°F, respectively.

Figure 6.6 shows the annual reference evapotranspiration (ET_o) rate reported at the Modesto CIMIS station near TID. Between water years 1988 and 2024, the average annual ET_o was 53.4 inches per year, ranging from a high of nearly 59.4 inches in 2021 to a low of 45.8 inches in 2005. The average ET_o over the last 10 years (2015-2024) was 55.7 inches, 3.1 inches higher than the period 1988-2014, which was 52.6 inches.

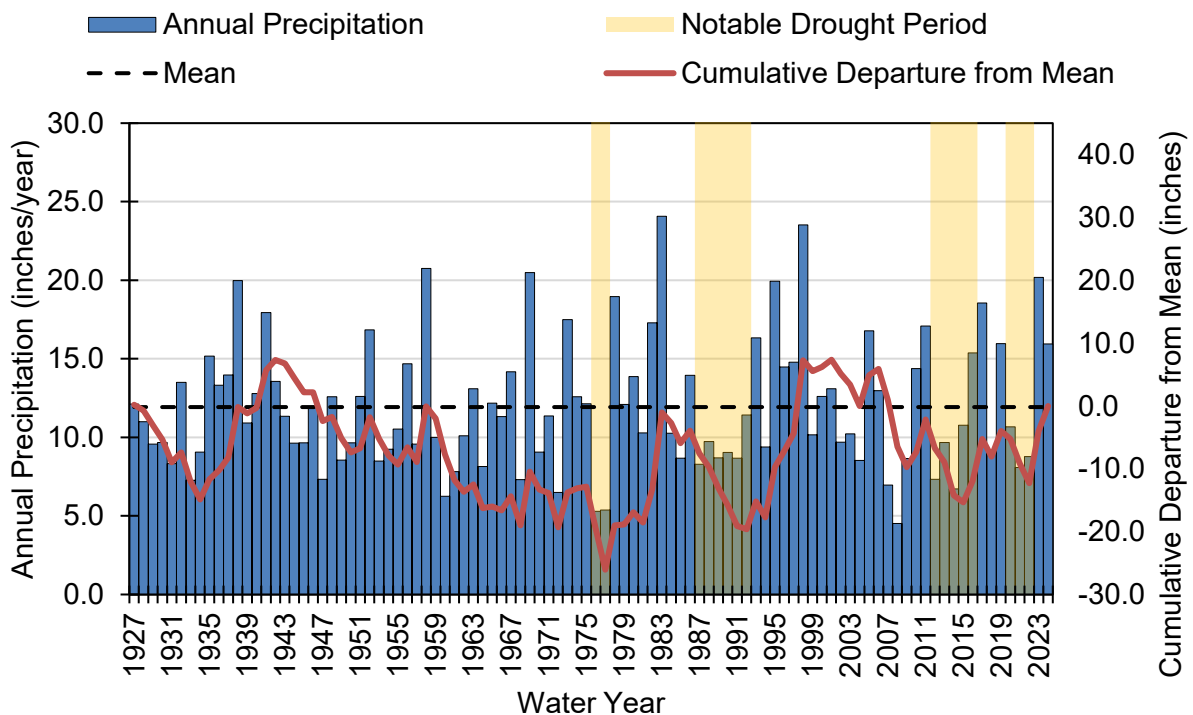


Figure 6.4. Historical Annual Precipitation and Cumulative Departure from the Mean Annual Precipitation.

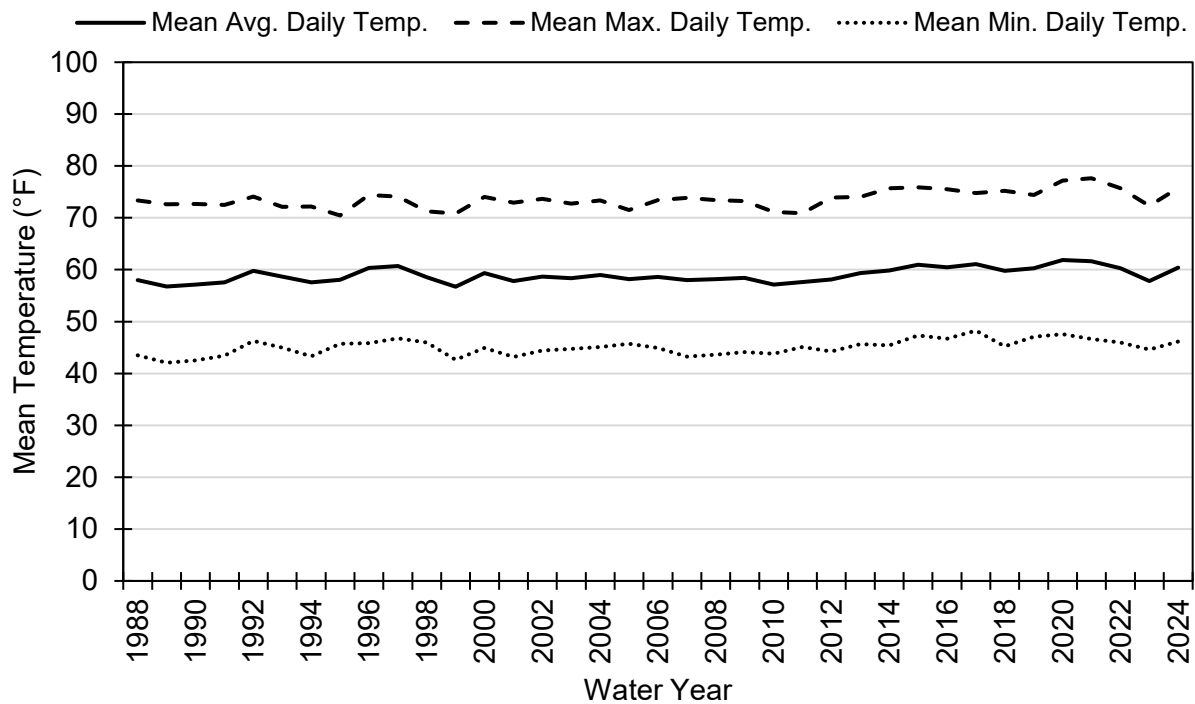


Figure 6.5. Historical Mean Daily Temperatures at the Modesto CIMIS Station.

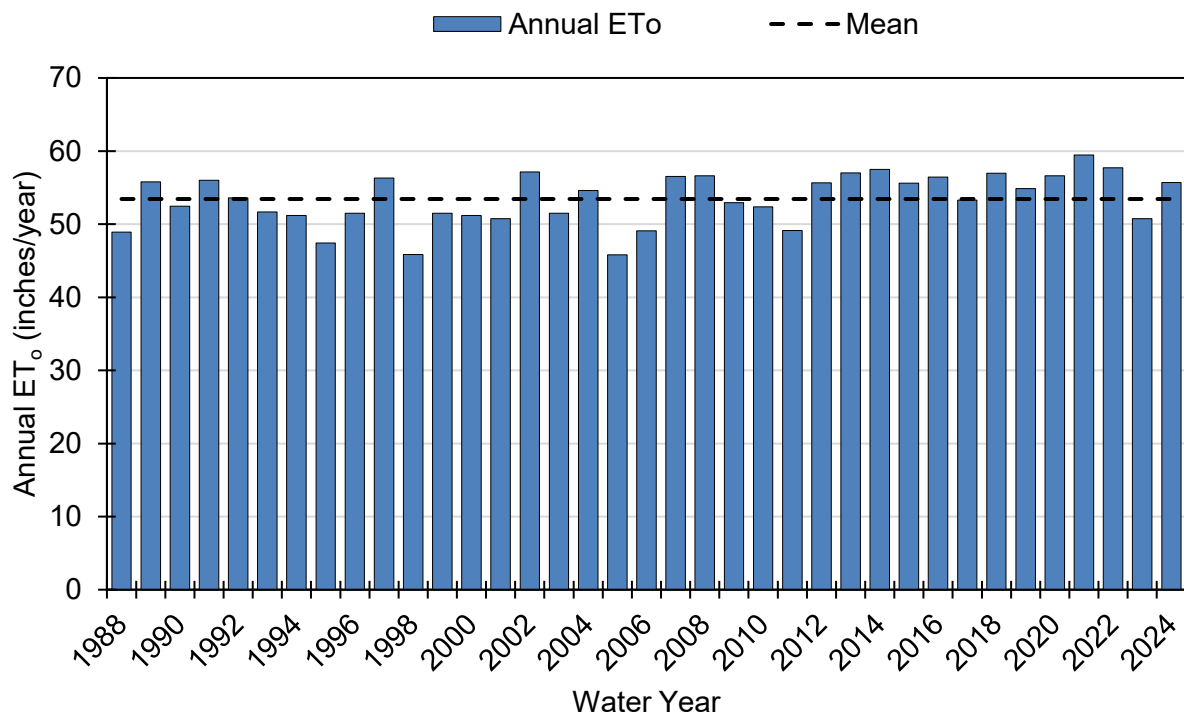


Figure 6.6. Historical Annual Reference ET at the Modesto CIMIS Station.

With increasing temperatures, future crop evapotranspiration (ET) is expected to rise. Crop ET for the historical period and under three future climate scenarios was estimated as the product of the crop coefficient and the reference ET. The VIC model calculated reference ET for all climate scenarios using the physically based Penman–Monteith approach, as described in the Food and Agriculture Organization (FAO) Report 56 (FAO 56). In the model, reference ET represents potential evapotranspiration from a short reference crop (grass).

To remove model bias, the reference ET estimated by the VIC model was scaled to match the annual reference evapotranspiration rate reported at the Modesto CIMIS station. The same bias-correction scaling was then applied to the three modeled climate scenarios (Warmer–Drier, Medium, and Hotter–Wetter).

Monthly crop coefficients for the period 2020–2024 were calculated from the water balance average crop ET and ETo reported at the Modesto CIMIS station. Assuming static crop phenology (process of crop growth and yield formation), future crop ET values were then computed as the product of the crop coefficients and the scaled VIC ETo values. It should be noted that the use of static phenology is a conservative planning assumption that could result in higher crop ET values compared to a non-static phenology assumption.

Average air temperature in TID is projected to increase in future periods under each of the three scenarios, as shown in **Figure 6.7**. Projected temperature increases by 2072 are 3.6°F for the less warming, 5.1°F for medium warming, and 7.0°F for hotter scenarios.

Potential changes in precipitation resulting from climate change are relatively uncertain for California’s Central Valley due to uncertainty in the future position of the jet stream. As a result, some GCMs and greenhouse gas emission scenario combinations predict increased precipitation under climate change, while other combinations predict decreased precipitation. Percent changes in projected average annual precipitation for TID are shown in **Figure 6.8**. The drier scenario shows a decrease in annual precipitation of -9.7% in TID while the wetter scenario shows an increase of 13.3%. The medium scenario (that includes precipitation projections between 25th and 75th percentiles) shows a decrease of -2.6% in annual precipitation in TID in 2072.

The changes in reference ET and crop ET for the three climate scenarios are shown in Figures 6.9 and 6.10. For all scenarios, increases in reference ET and crop ET are projected. Due to future warming, reference ET in 2072 is expected to increase by 6.0%, 7.7%, and 9.2% for Warmer-Drier, Medium, and Hotter-Wetter scenarios, respectively. Assuming static phenology, crop ET is also projected to increase by similar amounts for all scenarios to reference ET (5.9%, 7.6%, and 9.2% respectively).

Projected crop ET estimates here assume static phenology for annual crops rather than non-static phenology. Non-static phenology is believed to be more accurate as plant growth depends heavily on temperature. With expected increases in temperature across all scenarios, crop growing seasons are expected to be shorter as crops grow faster. This effect is not accounted for in static phenology. Because about 50 percent of the TID irrigated area is cropped in annual crops which exhibit non-static phenology, the percent change in actual ET may be lessened relative to the percents described above.

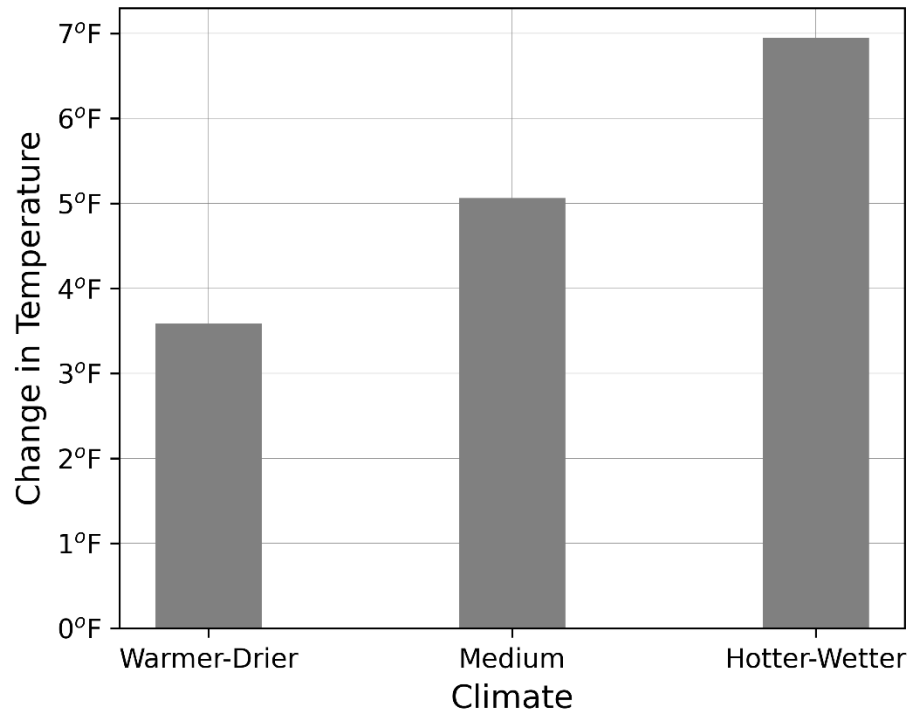


Figure 6.7. Projected Temperature Change by 2072 under Future Climate Scenarios

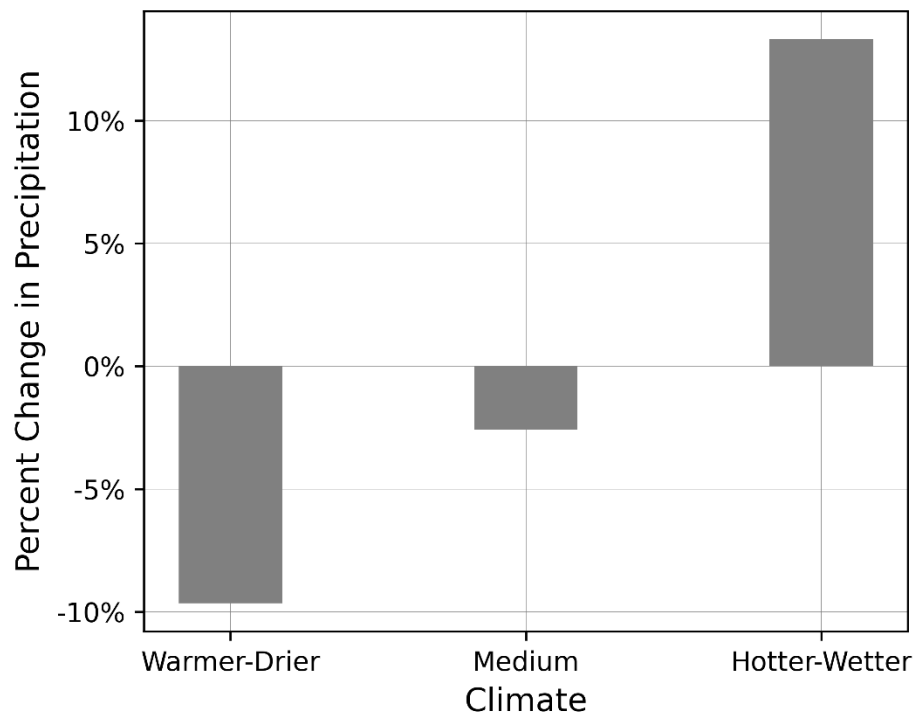


Figure 6.8. Projected Precipitation Change by 2072 under Future Climate Scenarios.

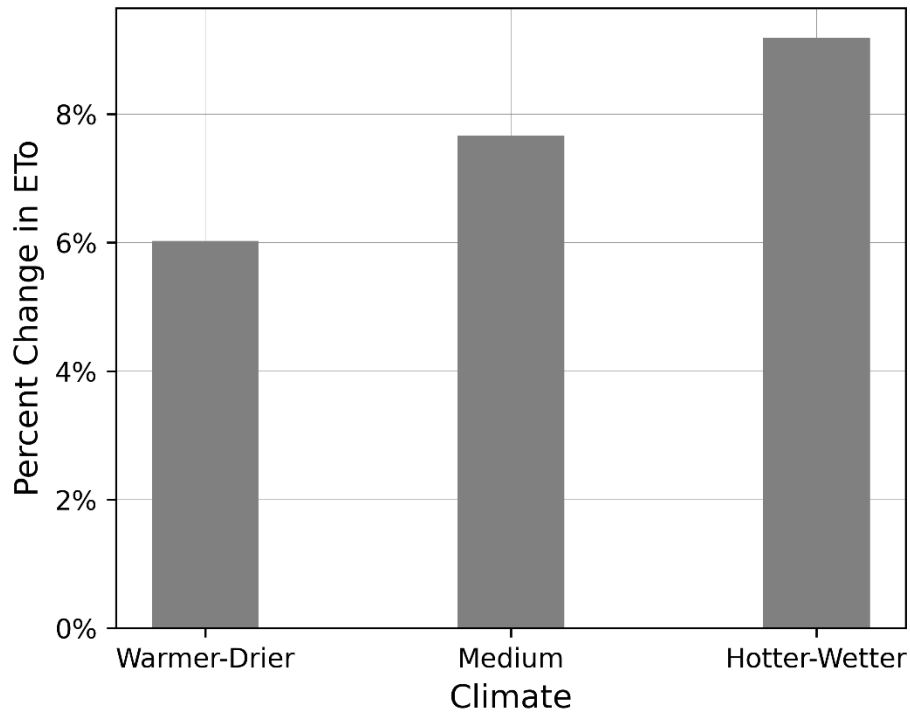


Figure 6.9. VIC Projected Reference ET Change by 2072 under Future Climate Scenarios.

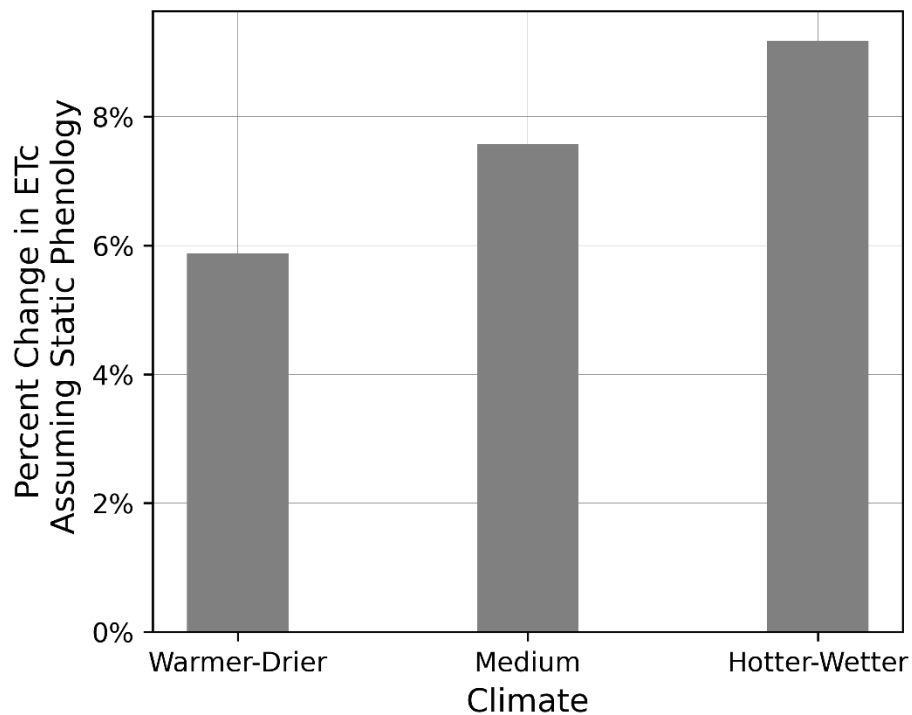


Figure 6.10. VIC Projected ET Change by 2072 under Future Climate Scenarios, Assuming Static Phenology.

6.3 POTENTIAL IMPACTS ON WATER SUPPLY AND QUALITY

The shift in runoff to the winter period and projected reduction in total runoff have the potential to impact surface water supply in the future if sufficient storage is not available to retain winter runoff until it is needed to meet irrigation demands and to provide additional carryover storage from wet years to dry years. As described earlier in this Plan, TID is undertaking managed aquifer recharge projects as part of GSP implementation. These projects expand TID's conjunctive management strategy and utilize natural infrastructure storage in the aquifer to retain winter runoff. Additionally, TID is studying possible locations for additional surface storage.

Increased erosion and turbidity under climate change would be unlikely to significantly affect the water quality of the Tuolumne River. Additionally, there are no known contaminants that could be concentrated at levels that would affect agricultural irrigation if spring runoff were to decrease, particularly due to the dilution of such contaminants in reservoirs upstream of the District.

However, increased water temperature could exacerbate the challenges of controlling aquatic plants in TID's distribution system to maintain capacity, provided that the temperature increase is great enough to escalate plant growth. Increased turbidity and algae growth in the canals, if substantial, could pose challenges to irrigators that must filter canal water for their micro irrigation systems.

According to the East Stanislaus Region Integrated Regional Water Management Plan (ESRIRWMP, 2018) and other sources, climate change is expected to bring more frequent and more severe droughts in the future. Changing rainfall patterns could affect the volumes and patterns of groundwater recharge provided from infiltration of precipitation and runoff. Groundwater pumping volumes have historically been at their greatest during droughts because there is less surface water to meet water demands.

TID's conjunctive management strategy is important to maintaining water supply reliability in an uncertain future. TID's stable surface water supply and tiered water pricing strategy encourage irrigators to use surface water in wetter years, resulting in significant in-lieu recharge through reduced pumping and direct recharge through infiltration. TID also utilizes shallow groundwater wells and rented deep wells to supplement surface water supply in drier years. Additionally, individual growers may also supplement surface water supply with groundwater produced by private wells in dry years. TID has developed and implemented methods to monitor and model groundwater extractions and recharge in the District's service area. TID has been actively involved in groundwater management planning in the region for years and is currently involved in the implementation of the Groundwater Sustainability Plan (GSP) for the Turlock Subbasin as a member of the West Turlock Subbasin Groundwater Sustainability Agency (WTSGSA), one of the two GSAs within the Subbasin.

6.4 POTENTIAL IMPACTS ON WATER DEMAND

As discussed in **Section 6.2.2.3**, crop ET is expected to increase in the future because of climate change, including projected temperature increases and changes in other climate factors. The net irrigation water requirements (NIWR) of crops – the fraction of crop ET that must be met

through irrigation – are also expected to increase for all climate scenarios considered in this analysis.

For this climate analysis, NIWR is computed as the difference between crop ET and the portion of crop ET met by precipitation, which was estimated by the VIC model. To reduce potential model biases, the VIC model estimates of monthly crop ET met by precipitation were scaled to match the observed monthly crop ET met by precipitation under historical conditions. The same scaling was also applied to bias-correct crop ET met by precipitation under future climate scenarios.

Projected changes in NIWR for the three scenarios are shown in **Figure 6.11**. Under static crop phenology, projected NIWR in TID increases by 8.7%, 9.5%, and 8.6% for the Warmer–Drier, Medium, and Hotter–Wetter scenarios, respectively.

Future changes in the timing and amount of precipitation could also lead to greater irrigation requirements to meet ET demands. In addition, shifts in the timing of crop planting, development, and harvest could alter the seasonal distribution of irrigation demand. All these factors have the potential to affect NIWR.

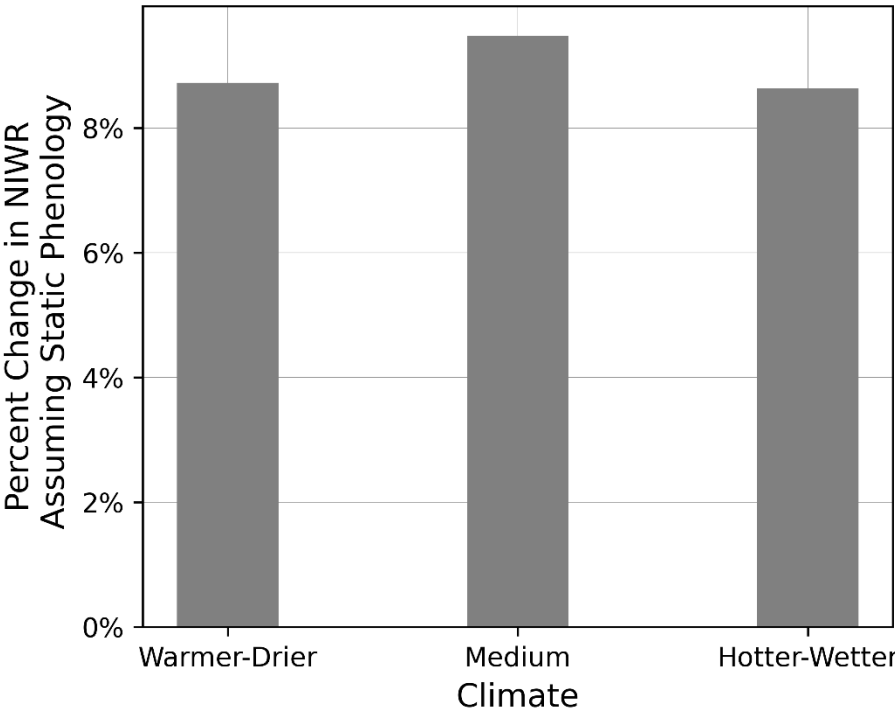


Figure 6.11. Projected Net Irrigation Water Requirement Change Assuming Static Phenology by 2072 under Future Climate Scenarios.

For this analysis, several uncertainties are acknowledged. For example, the effects of carbon dioxide (CO₂) on irrigation demand are estimated using physiological crop growth models and were not included in the VIC estimates. In general, increased atmospheric CO₂ is expected to reduce stomatal conductance and transpiration, which would contribute to reduced ET, all other factors remaining equal. Changes in the types of crops grown, irrigated area, and irrigation efficiencies are likely to affect the amount of irrigation water requirements.

6.5 STRATEGIES TO MITIGATE CLIMATE CHANGE IMPACTS

Although TID recognizes that climate change is occurring and the scientific evidence shows that the effects of climate change are already being observed, there remains some uncertainty about timing and magnitude of future climate change impacts. The District will mitigate climate change impacts with this uncertainty in mind through an adaptive management approach in cooperation with other regional stakeholders, including municipalities within the District, neighboring irrigation districts, and other interested parties. Under adaptive management, key metrics and uncertainties will be identified and monitored (e.g., April – July runoff as a percentage of annual runoff, total runoff, average temperature, and reference evapotranspiration), and strategies will be developed to address the related climate change impacts. As the impacts are observed to occur, the strategies will be prioritized, modified as needed, and implemented.

6.5.1 Ongoing Climate Change Preparedness

Described below are several of the ongoing programs and planning efforts that TID is implementing to mitigate climate change impacts. These programs highlight TID’s leadership in adapting and responding to climate change.

6.5.1.1 *Airborne Remote Sensing for Snowpack Program*

Emerging technologies have made it possible to use aerial remote sensing to collect snow data and calculate snow water content across a large area and variable conditions.

In the Airborne Remote Sensing for Snowpack Program (ARSS), TID uses aerial snow monitoring tools and data to precisely map and quantify the water content of snow in the Upper Tuolumne River Watershed. This information, also supplemented with conventional snow surveys, allows TID to more accurately forecast runoff and to more efficiently manage water for purposes such as flood control, dam safety, water supply, groundwater recharge, and environmental objectives.

In all years, ARSS supports TID in making more informed water management decisions in response to actual, on-the-ground conditions. In dry years and drought periods, ARSS benefits the District’s ability to conserve water supply storage by helping TID staff to determine when and how much flood space will be needed in reservoirs to ensure public safety.

TID has been using this technology since 2013, when the National Aeronautics and Space Administration Jet Propulsion Laboratory (NASA-JPL) began research and development with this technology in the Tuolumne River watershed. Since 2018, when NASA-JPL research concluded, TID has been a leader in developing a cooperative, operational program under DWR for use in several basins throughout the Central and Southern Sierra Nevada. More information is available on TID’s website: <https://www.tid.org/irrigation/reservoir-river-conditions/airborne-snow-observatory/>.

6.5.1.2 Forecast-Coordinated Operations (F-CO) for the San Joaquin River watershed, and the TID Forecast-Informed Reservoir Operations (FIRO) Program

In 2009, DWR, the National Weather Service California-Nevada River Forecast Center, and the U.S. Army Corps of Engineers initiated the Forecast-Coordinated Operations (F-CO) Program for the San Joaquin River watershed. The F-CO Program allows DWR and other agencies to improve management of flood control pools to reduce peak flood flows downstream through the use of improved watershed and river forecasting and the coordination of releases during flood control operations.

TID's Forecast-Informed Reservoir Operations (FIRO) program is a reservoir-operations forecasting strategy that TID developed over the decades to strategically manage the District's surface water supplies and storage capacity at Don Pedro Reservoir. Through FIRO, TID brings together improved hydrologic monitoring, weather forecasting, and water supply forecasting to optimize the balance of flood protection and water supply storage for TID and its customers.

TID has been using this technology in conjunction with ARSS since 2017, providing staff the information needed to optimize reservoir storage in wet and dry years. In wet years, information assembled through FIRO and ARSS allow TID to create space in the reservoir through pre-flood releases to minimize the effects of storms forecasted to hit the area. In dry years, accurate forecasts of weather events and runoff allows storage of flows that may otherwise be released.

Since 2016, TID has utilized grant monies under the F-CO Program to:

- add additional weather stations and improve the technology of existing weather stations throughout the watershed,
- add additional streamflow and reservoir gages and improve the technology of existing gages throughout the watershed,
- improve the technology and efficiency of data sharing among agencies and the public,
- improve runoff forecasting technology, and
- gather refined snowpack data collection through use of airborne remote sensing for snowpack.

Information gathered through watershed monitoring directly benefits TID's understanding of watershed runoff and flood characteristics, and ability to conserve this water.

6.5.1.3 Hydrocomp and Hydrologic Modeling of the Tuolumne River Watershed

In 1997, TID implemented a calibrated internal hydrologic model for the Tuolumne River watershed. This model, the Hydrocomp Forecast and Analysis Model (HFAM), was developed by Hydrocomp and provides both deterministic and probabilistic forecasts of watershed and reservoir conditions. In recent years, the HFAM model has been used again to study climate change impacts to the Tuolumne River watershed. A reservoir operation tool is currently under development to optimize system requirements based on both value and risk. This tool will further support TID's preparedness and response to the effects of climate change in the future.

6.5.1.4 Weather Generator Model

TID is considering development of a weather generator model can create ensembles of climate scenarios across the Tuolumne River watershed for evaluating the vulnerability of water systems and effectiveness of adaptation strategies under climate change. With such a model, TID can generate synthetic weather with its own time series of multi-site data (rather than relying on baseline climate dataset), incorporate characteristics of atmospheric rivers, and apply the synthetic data in other modeling applications.

6.5.1.5 Weather Resources Management Program

Since 1990, TID has had a weather resources management program (WRMP) for precipitation augmentation by use of aerial cloud seeding. This program takes advantage of the orographic precipitation process by introducing ice nuclei to storms with clouds containing super-cooled liquid water (i.e., water that is below freezing temperature but remains liquid in form for lack of crystallization nuclei that allows precipitation). The WRMP allows TID to draw more precipitation from storms that otherwise would be less efficient, which helps TID to offset the broadening range of annual meteorological and hydrological conditions.

6.5.1.6 Sustainable Groundwater Management Efforts

TID is actively participating in local groundwater initiatives and efforts for compliance with the Sustainable Groundwater Management Act of 2014 (SGMA), including membership in the WTSGSA and implementation of the approved Turlock Subbasin GSP. Intentional, sustainable groundwater management in the Turlock Subbasin through GSP implementation will protect these groundwater resources for TID, its customers, and other beneficial users.

In December 2025, DWR released the “Tuolumne Watershed Study Area Report” which was one of five watershed reports that comprise the San Joaquin Basin Flood-MAR Watershed Studies. According to DWR, the effects of climate change will exacerbate long-standing water management challenges San Joaquin Basin. DWR proposes a strategy called Integrated-Forecast Informed Resource Management (I-FIRM) where forecast-informed reservoir operations (FIRO) is combined with managed aquifer recharge (MAR). In this manner, the impacts of floods are mitigated through enhanced reservoir management and groundwater recharge. TID partnered with DWR in the preparation of the report as TID is interested in how an integrated, watershed-scale approach using recharge can build resilience for the Tuolumne watershed study area by turning floodwaters into a critical resource for a sustainable future.

6.5.1.7 Tuolumne River Management Plan

Together with the Modesto Irrigation District, TID has developed a comprehensive management plan for the Tuolumne River, covering proposed operations, improvements, and resource protection measures under a new Federal Energy Regulatory Commission (FERC) license for the Don Pedro Project. The goals of this plan balance the needs of the many and varied uses of Tuolumne River water, including agricultural, municipal, recreational, riparian, and environmental users. This plan supports adaptation to climate changes, providing a clear and

balanced plan for the sustainable use of available runoff into the future. Additional information is provided on the Tuolumne River Management Plan Website.²⁸

6.5.1.8 Data management with KISTERS

KISTERS provides TID with a flexible data management system designed to automatically collect and manage large volumes of water data. Specifically, the Water Information System KISTERS (WISKI) serves as a centralized data management and decision-support software solution, enabling TID to manage more than 250,000 acres and serve over 4,900 irrigation customers.

6.5.2 Summary of Climate Change Mitigation Strategies

Several strategies for mitigating the climate change impacts to agricultural water providers and other water resources entities have been identified. These strategies include those identified as part of the California Water Plan published in 2009 and updated in 2013, 2018, and 2023 (DWR, 2010a, 2013, 2018a, and 2023), as well as strategies identified as part of the California Climate Adaptation Strategy (CNRA, 2009, and 2021) as part of the Sacramento and San Joaquin Basins Study (USBR, 2016b) and California's Water Supply Strategy, Adapting to a Hotter, Drier Future (August 2022). The District is already implementing many of the strategies applicable to irrigation districts in an appropriate form and at an appropriate level to meet local water management objectives.

Resource strategies that are being implemented or could be implemented by the District to adapt to climate change are summarized in **Table 6.1**.

6.6 ADDITIONAL RESOURCES FOR WATER RESOURCES PLANNING FOR CLIMATE CHANGE

In addition, several studies that evaluated the potential effects of climate change on the Tuolumne River watershed, much work has been done at the State and regional levels to evaluate the effects and impacts of climate change and to develop strategies to manage available water resources effectively under climate change. The following lists of resources provide additional information describing water resources planning for climate change:

6.6.1 Local and Regional Resources

- Sensitivity of Upper Tuolumne River Flow to Climate Change Scenarios. Hydrocomp, Inc.; San Francisco Public Utilities Commission; and Turlock Irrigation District. January 2012. (Hydrocomp et al., 2012)
- East Stanislaus Region Integrated Regional Water Management Plan. 2013. Available at: <http://www.eaststanirwm.org/>. (ESRIRWMP, 2015)
- East Stanislaus Region Integrated Regional Water Management Plan Update. 2018. Available at: <http://www.eaststanirwm.org/>. (ESRIRWMP, 2018)

²⁸ <http://www.tuolumnerivermanagementplan.com/#environmental-flows>.

- San Joaquin Valley Summary Report, Preview. California’s Fourth Climate Change Assessment. 2018. Available at: <https://climateassessment.ca.gov/regions/>.
- Eastern San Joaquin Groundwater Subbasin Groundwater Sustainability Plan. Eastern San Joaquin Groundwater Authority. November 2019 (revised June 2022). Available at: <https://www.esjgroundwater.org/Resource-Information/GSP>
- Merced Groundwater Subbasin Groundwater Sustainability Plan. Woodard & Curran. November 2019 (Revised July 2022). Available at: <http://www.mercedsgma.org/resources#documents>.
- San Joaquin Basin Flood-MAR Watershed Studies: Tuolumne Watershed Study Area Report. DWR 2025

Table 6.1. District Strategies to Mitigate Climate Change Impacts.

Source	Strategy	Status
California Water Plan (DWR 2010a, 2013, 2018a, and 2023)	Reduce water demand	The District is implementing all technically feasible and locally cost-effective EWMPs identified by SBx7-7 to improve water use efficiency in District operations and to encourage on-farm improvements. Additional actions to reduce water demand are considered on an ongoing basis as part of TID’s water management activities.
	Improve operational efficiency and transfers	As described above and elsewhere in this AWMP, the District has and continues to implement improvements to increase operational efficiency.
	Increase water supply, through, increased storage, recharge and sustainable groundwater management	The District has increased its available water supply through conjunctive management of available groundwater supplies, through reuse of drainage water, through improved forecasting of the runoff from the upper watershed, and through other innovative technologies. Irrigators within TID use recycled processing water from Hilmar Cheese and recapture drain water for irrigation. TID also actively forecasts runoff and manages its water supply through the ARSS, F-CO, FIRO, and watershed monitoring programs. Data and tools available through these programs allow TID to better track and understand the amount of water in the upper watershed, informing reservoir operations to optimize the balance of available flood storage and water supply storage. Additionally, TID, in conjunction with MID, has implemented a cloud seeding program to maximize surface water supplies available from Tuolumne River. In the future, the District will seek additional opportunities to increase available water supply, including increased conjunctive management through consideration of opportunities to increase groundwater recharge to increase available groundwater supply to compensate for reduced April through July runoff. As a member of the WTSGSA, TID is actively engaged in SGMA efforts and is supporting the implementation of the approved GSP for the Turlock Subbasin. Among these efforts, TID staff has been responsible for administering grants to support GSP development, development of a Groundwater Recharge Assessment Tool for the Subbasin, the installation of monitoring wells, and creation of a Programmatic Environmental Impact Report for the GSP. Implementation of the GSP includes expanding managed aquifer recharge as part of TID’s conjunctive management program to sustainably manage groundwater in the Turlock Subbasin.

Source	Strategy	Status
	Improve water quality	The District will continue to monitor surface water and groundwater quality as part of its active water quality monitoring program, and the coordination with monitoring programs conducted by others, including: regular ag suitability monitoring at Turlock Lake and spills, sampling and analysis of TID-owned and rented wells, ag suitability monitoring of subsurface drain discharges to the TID distribution system, real-time monitoring of canal and drain spill locations, and monitoring required for TID's use of aquatic herbicides.
	Practice resource stewardship	The District supports the stewardship of agricultural lands within and surrounding its service area through its irrigation operations and resulting groundwater recharge. The District participates in studies of aquatic life and habitat to better understand potential impacts of climate change. TID also supports stewardship of surface water and groundwater supplies, as evidenced through its comprehensive conjunctive management program, watershed monitoring programs, development of the Tuolumne River Management Plan, and active engagement in GSP implementation for the Turlock Subbasin, among other efforts.
	Improve flood management	TID actively forecasts runoff and manages flood storage through the ARSS, F-CO, FIRO, and watershed monitoring programs. Data and tools available through these programs allow TID to better track and understand the amount of water in the upper watershed, informing reservoir operations to optimize the balance of available flood storage and water supply storage. The District is required to follow the flood management criteria established by the Army Corps of Engineers at Don Pedro Reservoir. In addition, its irrigation and drainage systems provide a passive system to collect and convey winter runoff. If runoff characteristics change substantially within the District in the future, modifications to the irrigation and/or drainage system to increase capacity or mitigate other impacts will be considered.
	Engage people in water management	TID offers affordable surface water in all years, with a tiered pricing structure that incentivizes surface water use and groundwater recharge in normal years, and water conservation in dry years. As described in Section 7.4.12, TID also offers a variety of agricultural water management educational programs and materials for farmers, staff, and the public.
	Support Long-Term and Regional Water Management Planning	The District collects, manages, and reports a wide array of data related to the District's operations and water management efforts. The District is actively involved in regional surface water and groundwater management planning.
	Improve Forecasting, Data, and Management	The District uses a flexible data management system, KISTERS, to automatically collect and manage large volumes of water data. The District actively uses forecast-informed reservoir operations (FIRO) to inform Don Pedro Operations decisions.
	Other strategies	Other strategies include crop idling, irrigated land retirement, and rainfed agriculture. Under severely reduced water supplies, growers could consider these strategies; however, it is anticipated that climate change impacts will be mitigated through the other strategies described.
California Climate	Aggressively increase water use efficiency	Described above under "Reduced water demand" and "Improve operational efficiency and transfers."

Source	Strategy	Status
Adaptation Strategy (CNRA 2009 and 2021)	Practice and promote integrated flood management	Described above under "Improve flood management."
	Enhance and sustain ecosystems	Described above under "Practice resource stewardship."
	Expand water storage and conjunctive management	Described above under "Increase water supply."
	Fix Delta water supply	Not applicable to the District.
	Preserve, upgrade, and increase monitoring, data analysis, and management	The amount of information and analysis available to support the District's water management is extensive and continues to increase substantially. For example, TID staff monitors the quantity and quality (EC and temperature) of water in the distribution system on a real-time basis to support operations and conjunctive management. TID has also expanded SCADA monitoring and automation of canal structures over time. TID's water balance analysis is updated on an annual basis to inform near- and long-term water management decisions. TID also conducts extensive monitoring throughout the upper Tuolumne River watershed and implements several innovative programs to forecast runoff and manage reservoir operations, including ARSS, F-CO, FIRO, and HFAM.
	Plan for and adapt to sea level rise	Projections indicate that sea levels could rise by 2 to 5 feet by 2100. Direct impacts on the District are not anticipated.
Sacramento and San Joaquin Basins Study (USBR, 2016b)	Reduce water demand	Described above under "Reduce water demand"
	Increase water supply	Described above under "Increase water supply, including through recharge and sustainable groundwater management"
	Improve operational efficiency	Described above under "Improve operational efficiency and transfers." The District has and continues to implement improvements to increase operational efficiency through SCADA monitoring and automation, canal lining and improvements, conjunctive use management, and the many other efforts described as EWMPs in Section 7.
	Improve resource stewardship	Described above under "Practice resource stewardship."
	Improve institutional flexibility	TID cooperates with Modesto Irrigation District, which co-owns Don Pedro Reservoir with TID, and works with agencies that affect the flexibility with which TID can store and deliver water, including the Federal Energy Regulatory Commission (FERC) and the U.S. Army Corps of Engineers. TID also implements ARSS, FIRO, and watershed monitoring to better track and understand the amount of water in the upper watershed and optimize reservoir operations to balance flood storage and water supply storage
	Improve data and management	Described above under "Preserve, upgrade, and increase monitoring, data analysis, and management."

6.6.2 State Resources

- Central Valley Flood Protection Plan (CVFPP) 2022 Update, Technical Analyses Summary Report, November 2022, Available at <https://cvfpp.ca.gov/cvfpp/>

- Progress on Incorporating Climate Change into Planning and Management of California's Water Resources. California Department of Water Resources. July 2006. (DWR 2006)
- 2009 California Climate Change Adaptation Strategy. California Natural Resources Agency. December 2009. (CNRA, 2009)
- 2021 California Climate Change Adaptation Strategy. California Natural Resources Agency. 2021. (CNRA, 2021)
- Managing An Uncertain Future: Climate Change Adaptation Strategies for California's Water. California Department of Water Resources. October 2008. (DWR, 2008)
- Managing an Uncertain Future. California Water Plan Update 2009. Volume 1, Chapter 5. March 2010. (DWR, 2010a)
- Climate Change Characterization and Analysis in California Water Resources Planning Studies. California Department of Water Resources. December 2010. (DWR, 2010b)
- Climate Change Handbook for Regional Water Planning. Prepared for U.S. Environmental Protection Agency and California Department of Water Resources by CDM. November 2011. (CDM, 2011)
- Climate Change and Integrated Regional Water Management in California: A Preliminary Assessment of Regional Perspectives. Department of Environmental Science, Policy and Management. University of California at Berkeley. June 2012. (UCB, 2012)
- California Adaptation Planning Guide: Planning for Adaptive Communities. California Emergency Management Agency and California Natural Resources Agency. July 2012. (Cal EMA and CNRA, 2012)
- Managing an Uncertain Future. California Water Plan Update 2013. Volume 1, Chapter 5. 2013. (DWR, 2013)
- Perspectives and Guidance for Climate Change Analysis. California Department of Water Resources Climate Change Technical Advisory Group. August 2015. (DWR-CCTAG, 2015)
- Actions for Sustainability. California Water Plan Update 2018. Chapter 3. 2018. (DWR, 2018a)
- California Water Plan Update 2023. (DWR, 2023)
- Safeguarding California Plan: 2018 Update, California's Climate Adaptation Strategy. California Natural Resources Agency. January 2018. (CNRA, 2018)
- Indicators of Climate Change in California. Office of Environmental Health Hazard Assessment, California Environmental Protection Agency. May 2018. (Cal EPA, 2018)
- Climate Action Plan—Phase 1: Greenhouse Gas Emissions Reduction Plan. California Department of Water Resources. July 2020. (DWR, 2020)
- Climate Action Plan—Phase 2: Climate Change Analysis Guidance. California Department of Water Resources. September 2018. (DWR, 2018b)

- Climate Action Plan—Phase 3: Climate Change Vulnerability Assessment. California Department of Water Resources. February 2019. (DWR, 2019)
- Cal-Adapt website tools, data, and resources for exploring California’s climate change research and developing adaption plans. Available at <https://cal-adapt.org/>
- California’s Water Supply Strategy, Adapting to a Hotter, Drier Future (August 2022)

Other Resources

- Climate Change and Water. Intergovernmental Panel on Climate Change. June 2008. (IPCC, 2008)
- Climate Change and Water Resources Management: A Federal Perspective. U.S. Geological Survey. Circular 1331. 2009. (USGS, 2009)
- West-Wide Climate Risk Assessments: Irrigation Demand and Reservoir Evaporation Projections. Technical Memorandum No. 86-68210-2014-01. U.S. Bureau of Reclamation. 2015. Available at <https://www.usbr.gov/watersmart/baseline/docs/irrigationdemand/irrigationdemands.pdf> (USBR, 2015)
- SECURE Water Act Section 9503(c) – Reclamation Climate Change and Water 2016. March 2016. (USBR, 2016a).
- Sacramento and San Joaquin Rivers Basin Study. March 2016. (USBR, 2016b)

7. Efficient Water Management Practices

7.1 INTRODUCTION

This section describes the actions that TID has taken and is planning to take to accomplish improved and more efficient water management. These actions are organized with respect to the Efficient Water Management Practices (EWMPs) described in the California Water Code (CWC) §10608.48. The CWC lists two types of EWMPs: critical EWMPs that are mandatory for all agricultural water suppliers subject to the Code, and conditional EWMPs that are mandatory if found to be technically feasible and locally cost-effective.

The two mandatory, critical EWMPs are (1) measurement of the volume of water delivered to customers with sufficient accuracy for aggregate reporting, and (2) adoption of a pricing structure for water customers based at least in part on the quantity delivered.

TID has implemented the delivery measurement accuracy EWMP by implementing the corrective action plan included in the 2012 AWMP and updated in the 2015 and 2020 AWMP, which defined corrective actions, a budget, and a schedule to comply with the agricultural water delivery measurement regulations required by California Code of Regulations (CCR) Title 23 §597. The results of the corrective action plan are summarized below and described in detail in **Appendix F** of this 2025 AWMP.

TID has implemented the volumetric pricing EWMP since June 2012, when the TID Board of Directors adopted a volumetric pricing structure to be implemented beginning with the 2013 irrigation season. The volumetric rate structure was updated with a new structure and prices effective in 2025 and is described in **Section 2** of this AWMP.

TID has also implemented, and plans to continue implementing all additional (i.e., conditional) EWMPs that are technically feasible and locally cost-effective. **Table 7.1** describes each EWMP and summarizes TID's implementation status.

7.2 DELIVERY MEASUREMENT ACCURACY (10608.48.B(1))

STATUS: IMPLEMENTING

Sidegates²⁹ are the delivery points through which water is delivered from TID canals and laterals to customers. TID customers are the individual landowners (or land tenants) to whom TID delivers water, served either directly from the TID distribution system or through facilities owned by groups of landowners organized under Improvement Districts (IDs). TID measures water deliveries at the sidegate, where responsibility for water control and management is passed from TID to its customers.

²⁹“Sidegate” is the term that is used in TID for the “delivery point” defined in 23 CCR§597 as “...the location at which the agricultural water supplier transfers control of delivered water to a customer or group of customers....” (23 CCR §597.2(a)(6))

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Table 7.1. Summary of Critical and Conditional EWMPs (Water Code Sections 10608.48 b & c)

Water Code Reference No.	EWMP Description	Implementation Status	AWMP Section
Critical EWMPs – Mandatory			
10608.48.b(1)	Measure the volume of water delivered to customers with sufficient accuracy to comply with subdivision (a) of Section 531.10 and to implement 10608.48.b(2).	Implementing	7.2
10608.48.b(2)	Adopt a pricing structure for water customers based at least in part on quantity delivered.	Implementing	7.3
Additional (Conditional) EWMPs – To be Implemented if Locally Cost-Effective and Technically Feasible			
10608.48.c(1)	Facilitate alternative land use for lands with exceptionally high water duties or whose irrigation contributes to significant problems, including drainage.	Not Technically Feasible	7.4.1
10608.48.c(2)	Facilitate use of available recycled water that otherwise would not be used beneficially, meets all health and safety criteria, and does not harm crops or soils	Implementing	7.4.2
10608.48.c(3)	Facilitate financing of capital improvements for on-farm irrigation systems	Implementing	7.4.3
10608.48.c(4)	Implement an incentive pricing structure that promotes one or more of the following goals: (A) More efficient water use at farm level, (B) Conjunctive use of groundwater, (C) Appropriate increase of groundwater recharge, (D) Reduction in problem drainage, (E) Improved management of environmental resources, (F) Effective management of all water sources throughout the year by adjusting seasonal pricing structures based on current conditions.	Implementing	7.4.4
10608.48.c(5)	Expand line or pipe distribution systems, and construct regulatory reservoirs to increase distribution system flexibility and capacity, decrease maintenance and reduce seepage	Implementing	7.4.5
10608.48.c(6)	Increase flexibility in water ordering by, and delivery to, water customers within operational limits	Implementing	7.4.6
10608.48.c(7)	Construct and operate supplier spill and tailwater recovery systems	Implementing	7.4.7
10608.48.c(8)	Increase planned conjunctive use of surface water and groundwater within the supplier service area	Implementing	7.4.8
10608.48.c(9)	Automate canal control structures	Implementing	7.4.9
10608.48.c(10)	Facilitate or promote customer pump testing and evaluation	Implementing	7.4.10
10608.48.c(11)	Designate a water conservation coordinator who will develop and implement the water management plan and prepare progress report.	Implementing	7.4.11
10608.48.c(12)	Provide for the availability of water management services to water users.	Implementing	7.4.12
10608.48.c(13)	Evaluate the policies of agencies that provide the supplier with water to identify the potential for institutional changes to allow more flexible water deliveries and storage.	Implementing	7.4.13
10608.48.c(14)	Evaluate and improve the efficiencies of the supplier's pumps.	Implementing	7.4.14

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TID has developed two approaches to comply with California Code of Regulations Title 23 Division 2 Chapter 5.1 Article 2 Section 597 (23 CCR §597) consisting of:

1. Installation of new permanent measurement devices at 153 sites (including 144 sidegates) to accurately measure deliveries to nearly 73,000 assessed acres, or approximately 47 percent of the District's service area
2. Development of calibrated flow rates specific to each sidegate-parcel-irrigation method-requested flow rate combination, which are used to accurately measure deliveries to more than 81,000 assessed acres, covering the remaining 53 percent of the District's service area.

In addition, in 2025, out-of-district services and monitoring sites were added, currently including four sites irrigating approximately 2,000 acre-feet. More sites will be added in 2026, with a maximum delivery capacity of up to 32,000 acre-feet of surplus water under full deployment.

As of 2019, TID has completed initial calibrations per the corrective action plan for all active sidegates that don't fall under DWR exemptions. Across both approaches, 100% of the assessed acreage served by active, non-exempted sidegates now receive deliveries through new permanent measurement devices or have calibrated delivery flow rates. Together, these approaches ensure that TID will comply with 23 CCR §597 while minimizing capital and ongoing operation and maintenance costs. TID plans to continue taking additional calibration measurements, as needed, to calibrate new flow requests from customers.

In 2019, the field-testing accuracy certification of new permanent measurement devices was completed. Only a few remaining actions were needed to certify calibrated delivery flows at existing sidegates in TID. These actions were planned for 2020 but were delayed due to COVID-19 public health guidelines. TID has since completed the final steps required for formal certification and verification of existing devices.

Appendix F describes TID's measurement program and the 2025 status of the process in greater detail.

7.2.1 New Permanent Measurement Devices

As of December 2019, new permanent measurement devices were installed at 142 sidegates, along with six new permanent measurement devices at sites downstream of sidegates³⁰, and three new permanent measurement devices at ID pipeline spillage sites. Most of these new permanent measurement devices are Rubicon SlipMeters and Rubicon FlumeMeters. Both of these devices use Rubicon's Sonaray measurement technology, and are laboratory certified to ± 2.5 percent flow rate accuracy (Judge, 2011). Field tests in California irrigation district conditions found that the Sonaray measurement was within ± 2.0 percent of a National Institute of Standards and Technology (NIST) certified magnetic flow meter (Hopkins and Johansen, 2011). To improve the measurement accuracy of delivery volumes, TID trains WDOs and irrigators to use the gates,

³⁰ Measurement devices downstream of sidegates are used primarily for ensuring that only one customer is irrigating, which allows TID to attribute the measurement at the sidegate to that customer. Due to the complexity of determining the travel time of delivery flows, these devices are not used directly in measurement calculations

and has made training videos in English and Spanish that are available on the TID web site and YouTube.³¹

In most installations, a SlipMeter completely replaces an existing sidegate and will automatically adjust its opening to accurately deliver a desired flow or maintain a specified gate opening. A few SlipMeters are mounted on frames in front of the existing sidegates. In these cases the sidegates are still manually adjusted to control the delivery flow rate, while the SlipMeter is primarily used as a measurement device. FlumeMeters are also installed in front of existing sidegates, so the FlumeMeter is primarily used as a measurement device. A few FlumeMeters are installed in ID pipeline structure boxes where the ID pipeline branches and are used to measure flow at the split. Both SlipMeters and FlumeMeters send digital data to TID in real time via TID's Supervisory Control and Data Acquisition (SCADA) system. TID has completed the installation of new permanent flow measurement devices. TID plans to continue to review delivery measurement accuracy and customer needs. TID has added additional permanent measurement devices based on this review and may install more permanent flow measurement devices in the future.

7.2.2 Flow Rate Calibration for Existing Sidegates

TID is employing three techniques to develop flow rate calibrations at existing sidegates, depending on conditions at each sidegate.

At existing sidegates with access vents that are not suitably located for delivery flow measurement and calibration using handheld measurement devices, a Rubicon FlumeMeter was temporarily installed and used to develop calibrated delivery flow rates for each sidegate-parcel-irrigation method-requested flow rate combination. These calibrated flow rates are calculated based on the average flow rate observed from the FlumeMeter continuous flow measurements available from SCADA. The Rubicon FlumeMeter was moved to another sidegate when at least one delivery event was measured for all active parcels served by a sidegate. In total, TID has used 129 mobile FlumeMeters to develop calibrated delivery flow rates at 550 existing sidegates that serve 1,196 parcels, representing 32,187 assessed acres, or approximately 21 percent of the District.

For sidegates with access vents in suitable locations for delivery flow measurement and calibration using handheld measurement devices, a handheld Hach FH950 electromagnetic flow meter was used to determine calibrated flow rates specific to each sidegate-parcel-irrigation method-requested flow rate combination. The Hach FH950 flow meter provides a "spot" flow rate measurement at a specific point in time using an access vent downstream of a sidegate. Hach FH950 meters were used at 349 sidegates serving 536 parcels that together represent 19,345 assessed acres, or approximately 13 percent of the District.

For parcels with pressurized on-farm systems served by existing sidegates, a handheld Fuji Portaflow ultrasonic flow meter was used to determine calibrated flow rates specific to each sidegate-parcel-irrigation method-requested flow rate combination. The Fuji Portaflow meter also provides a "spot" flow rate measurement at a specific point in time. Fuji Portaflow meters

³¹ <https://www.tid.org/irrigation/irrigation-information/how-to-operate-rubicon-equipped-sidegates/>

were used at 471 sidegates serving 877 parcels that together represent 29,798 assessed acres, or approximately 19 percent of the District.

7.2.3 Use of Calibration Flows in Delivery Records and Billing

To provide growers a consistent basis for planning irrigations during an irrigation season, TID provides customers with access to their calibrated flow rates for each of their sidegate-parcel-irrigation method-requested flow rate combinations. Customers are able to access this information either by phone through the Water Call Center or online by accessing their online water accounts. These calibrated delivery flow rates are based on all flow measurements completed prior to the beginning of the current irrigation season. The volume of water delivered during each irrigation event is calculated using these calibrated delivery flow rates and the recorded start and end times of the delivery event.

As future calibration measurements occur, calibrated flows will be updated at the end of each year by incorporating the new measurements into calibrated average flow rate. Growers will be able to access their new calibrated flow rates by phone or online, as described above.

TID has updated their water ordering, delivery, and billing software to use the calibrated flow rates for billing. For billing purposes, TID uses the calibrated flow average from the prior year to provide certainty to growers with respect to water costs. For reporting delivery volumes to DWR and for use in the TID water balance, TID updates the calibrated delivery flow rates at the end of each irrigation season and uses these updated values to calculate the measured volume of water delivered in the completed irrigation season. Additional information is given in **Appendix F**.

7.2.4 Certification of Measurement Accuracy

As the initial flow rate calibrations have been completed at all sidegates, and the software system changes have been implemented, TID has begun conducting a formal certification of the volumetric measurement accuracy consistent with 23 CCR §597.

To certify the volumetric measurement accuracy of all measurement devices, TID has evaluated both the accuracy of the recorded delivery duration and the accuracy of the flow rate measurement. The accuracy evaluations for both the new permanent measurement devices and the existing measurement devices are described in detail in **Appendix F**.

TID completed field-testing accuracy certification of new permanent measurement devices. Only a few remaining actions were needed to complete the field testing and accuracy certification for calibrated delivery flows at the remaining existing sidegates in TID. At the end of 2019, TID had developed a plan for completing these tasks in 2020 to validate the accuracy of deliveries to the remaining assessed area in TID (**Appendix F, Attachment F.1**). However, due to public health restrictions related to the COVID-19 pandemic, field-testing was delayed. TID has since completed all final steps required for formal certification. The results of these measurements are provided and discussed in **Appendix F**.

7.3 VOLUMETRIC PRICING (10608.48.B(2))

STATUS: IMPLEMENTING

TID adopted a volumetric pricing structure that has been in effect since the 2013 irrigation season. TID’s volumetric pricing structure was adopted in 2014 for implementation starting during the 2015 irrigation season, following completion of the Proposition 218 process. Recently, the volumetric rate structure was updated with a new structure and prices effective in 2025. A detailed description of the volumetric pricing structure is included in **Section 2** of this AWMP.

Originally, TID’s volumetric pricing structure included separate tiered-pricing structures for normal and dry years, with four water rate tiers in each year type that are defined based on the amount of water delivered per acre. The cost per acre-foot of water delivered increased as growers move from lower to higher tiers. A fixed fee per acre is also included. Effective in 2025, TID approved a 6.2% rate increase spread over three years. Tiers 1-3 will be consolidated into a single rate to encourage use of surface water in years it is available, while Tier 4 remains at \$20/AF. The fixed fee increases in dry year types.

TID has also updated the water ordering, delivery, and billing software to use the calibrated flow rates described in **Section 7.2** for billing purposes. With this update, TID’s customers are accurately billed for the quantity of water that is delivered.

7.4 ADDITIONAL CONDITIONAL EWMPs

California Water Code (CWC) §10608.48.c requires agricultural water suppliers to implement an additional 14 conditional EWMPs “if the measures are locally cost-effective and technically feasible.” As part of its ongoing water management activities, TID is implementing all of these measures, except one that is not technically feasible, as described in the following sections.

7.4.1 Facilitate Alternative Land Use (10608.48.c(1))

STATUS: NOT TECHNICALLY FEASIBLE

Facilitating alternative land use, as envisioned through implementation of this EWMP, is not technically feasible in TID. This EWMP was designed to focus on resolving problems for lands with exceptionally high water duties or lands where irrigation contributes to significant problems, including problem drainage. TID has neither of these conditions within the District boundaries. Furthermore, TID’s rules and regulations prohibit wasteful use of water, preventing exceptional water duties or significant problems from occurring (see **Section 2.2.4.1**).

According to the California Important Farmland Data collected and reported by the Farmland Mapping and Monitoring Program, most farmland within the TID service area is considered to be “prime farmland,” “farmland of statewide importance,” or “farmland of local importance.” These three categories include farmland with suitably high-quality physical and chemical features (e.g., soil quality, moisture supply, slope) to support long-term agriculture and the economy without significant problems (**Table 7.2**).

Some areas within TID require drainage to sustain maximum agricultural production. Shallow groundwater in these areas is suitable for irrigation and is used as a source of supply by TID and individual growers. Considering these factors, drainage does not pose a significant problem in TID.

Due to the factors described above, this EWMP is not technically feasible in TID, and is not currently being implemented. Should future conditions change such that this is not the case, TID will re-evaluate this EWMP.

Table 7.2. Farmland Classification within TID Boundaries, from the California Farmland Mapping and Monitoring Program, California Important Farmland Data, 2016.

Farmland Type ¹	Land Type Description	Percent Total Farmland Area within TID
Prime Farmland	Irrigated land with the best combination of physical and chemical features (e.g. soil quality, growing season, and moisture) to support long-term cropping	57%
Farmland of Statewide Importance	Irrigated land similar to Prime Farmland, with a good combination of physical and chemical features, but with minor shortcomings (e.g., soil type, etc.)	25%
Farmland of Local Importance	Land of importance to the local agricultural economy as determined by each county's board of supervisors and a local advisory committee	2%
Unique Farmland	Lesser quality soils used for the production of the state's leading agricultural crops.	16%
Total Farmland		100%

¹ Only includes land types classified as “farmland.” Other land uses ancillary to agriculture (grazing land, confined animal production facilities, and agricultural storage and packing facilities) are not included in this summary.

7.4.2 Facilitate Recycled Water Use (10608.48.c(2))

STATUS: IMPLEMENTING

TID is implementing this EWMP by facilitating the safe utilization of available recycled water. The District accepts recycled water from municipal and industrial users into its system provided that the dischargers have the appropriate National Pollutant Discharge Elimination System (NPDES) permits and are able to meet TID-specific requirements.

For 20 years, land in the TID service area has been irrigated using treated wastewater from the Cities of Modesto and Turlock. Land is also irrigated using untreated dairy nutrient water and industrial process water from Hilmar Cheese. The combined average volume of recycled treated wastewater used for irrigation was approximately 4,690 AF per year between 2020 and 2024.

TID assists growers who wish to receive nutrient water by allowing dairies to transport nutrient water through Improvement District (ID) conveyance structures. This recycling of dairy runoff reduces discharge, enables growers to utilize the nutrient water as fertilizer for forage crops, and provides water for irrigation.

Similarly, TID supports the practice of reusing industrial process water from Hilmar Cheese Company by allowing Hilmar Cheese to transport process water through ID conveyance structures. Using the existing ID facilities in this manner enables Hilmar Cheese to recycle the process water for agricultural use, and provides growers the benefit of water supply year-round, including the non-irrigation season when TID supplied irrigation water isn’t available. This type of reuse has increased over time as the Hilmar Cheese facility has diversified and expanded. Approximately 2,000 AF of process water is recycled per year, on average.

TID endeavors to use recycled treated wastewater where possible to meet non-irrigation needs as well. In May 2010, TID converted the water source for its cooling towers at the Walnut Energy Center in Turlock to tertiary treated wastewater effluent from the City of Turlock. TID has used approximately 1,000 AF per year of effluent, reducing TID’s non-irrigation pumping needs by an equivalent amount.

TID also recovers spillage from the Harding Drain for reuse along Lateral 5 ½. The Harding Drain is used to transport runoff, drainage from adjacent lands, groundwater accretions, and canal spillage. For the period from 2020 to 2024, an average of 1,860 AF of water per year was reused.

TID has been implementing and will continue to implement locally cost-effective and technically feasible practices consistent with this EWMP. TID continues to work with cities and permitted dischargers within its service area to gain access to recycled water supplies for agricultural needs. In the future, TID will continue to identify and evaluate opportunities for use of recycled water that conform to regulatory and agronomic water quality standards and resource requirements. TID also plans to begin using recycled “offset” water from SRWA in the next five years.

7.4.3 Capital Improvements for On-Farm Irrigation Systems (10608.48.c(3))

STATUS: IMPLEMENTING

TID is implementing the EWMP to facilitate capital improvements for on-farm irrigation systems through a variety of programs described below.

TID has an active financing program to support on-farm capital improvements of irrigation facilities through the formation of new Improvement Districts (IDs), and on-going maintenance and support of existing IDs. IDs are formed to allow groups of growers to pool resources to build, operate and maintain on-farm water distribution systems, subsurface drain systems, deep wells, and micro irrigation systems. There are currently 1,062 IDs including 250 deep well pumps, 1 booster pump, 62 drains and 749 irrigation ditches and pipelines that deliver water from the TID canals and laterals to individual growers. IDs own approximately 700 miles of lined irrigation delivery ditches and pipelines, serving 124,000 acres within TID.

TID offers low interest financing to IDs, generally with a 10-year loan term, and offers engineering design and installation oversight for these facilities. In addition, TID provides at-cost maintenance and repair for ID facilities. Financial assistance is further provided to each ID on a short-term basis through TID’s assessment process. Maintenance, electrical charges, and repairs for the year are carried by TID interest-free and billed to ID members in November of each year. ID members have the option of paying the assessment in two installments with no interest or penalties. For very large assessments, TID will work with an ID to establish a multiple-year assessment that distributes the costs over a longer period. Multiple-year assessments are also interest-free and typically last two to three years.

TID has also hired an assistant engineer with a background in agriculture whose primary work assignment is to provide on-farm technical support and design assistance to TID customers. Services include support of micro/drip conversion and on-farm reservoir sizing.

As a member of the West Turlock Subbasin Groundwater Sustainability Agency (WTSGSA), TID was actively involved in preparing the Turlock Subbasin Groundwater Sustainability Plan (GSP) that identifies the actions needed to achieve groundwater sustainability. The Turlock Subbasin GSP was formally adopted and includes projects that facilitate on-farm improvements that encourage continued use of surface water and groundwater recharge (On-Farm Recharge Project (in WTSGSA)).

TID continually searches for grants on behalf of the District and its customers, including those to support on-farm improvements.

TID has been implementing, and will continue to implement this EWMP. In the future, TID will continue to identify and evaluate opportunities to facilitate financial assistance for on-farm capital improvements.

7.4.4 Incentive Pricing Structure (10608.48.c(4))

STATUS: IMPLEMENTING

TID is implementing this EWMP by implementing a tiered, volumetric pricing structure that promotes the following goals identified in the CWC:

1. More efficient water use at the farm level
2. Conjunctive use of groundwater
3. Increased groundwater recharge
4. Effective management of all water sources throughout the year by adjusting seasonal pricing structures based on current conditions.

As described in **Section 2.2.3**, TID's volumetric pricing structure consists of separate tiered-pricing structures for normal and dry years, with four water rate tiers in each year type that are defined based on the amount of water delivered per acre. Effective in 2025, Tiers 1-3 were consolidated into a single rate, while Tier 4 remains the same. The fixed charge remains unchanged for both year types. The cost per acre-foot of water delivered increases as growers move from Tiers 1-3 to Tier 4, promoting efficient water use at the farm level and conjunctive use of groundwater (goals 1 and 2, above).

TID's pricing structure also promotes conjunctive use of groundwater, appropriate increases in groundwater recharge, and effective management of all water sources (goals 2, 3, and 4 above) by implementing separate normal year and dry year fixed fees per acre, with higher fixed fees in dry years. This pricing structure supports the District's overall conjunctive management strategy through the following mechanisms:

- Encouraging the use of available surface water supplies and groundwater recharge by keeping surface water rates low relative to the cost of groundwater pumping and
- Implementing the dry year fixed fee, enables the District to generate additional revenue to pay for increased groundwater pumping in dry years.

TID has been implementing, and will continue to implement this EWMP. In the future, TID will periodically review the volumetric pricing structure and rates with respect to TID's water management objectives.

7.4.5 Lining or Piping of Distribution System and Construction of Regulating Reservoirs (10608.48.c(5))

STATUS: IMPLEMENTING

TID has implemented this EWMP through:

- Lining or pipeline conversion of over 90 percent of its conveyance and distribution system
- Maintaining the canal lining through its active gunite and lining maintenance program
- Supporting Improvement Districts in their effort to maintain and improve ID-owned water conveyance facilities
- Evaluating the installation of regulating reservoirs, and – when locally cost-effective or deemed necessary for other reasons, such as improved customer service – installing regulating reservoirs along its distribution system.

7.4.5.1 Lining or Piping of Distribution System

TID's conveyance and distribution system (including the Upper Main Canal from La Grange to Turlock Lake) consists of approximately 240 miles of canals, of which 222 miles are fully or partially lined (92%). The remaining areas of unlined canals are primarily in upland clay soils with low seepage rates. The relatively small volume of seepage from the remaining unlined and partially lined canals provides beneficial groundwater recharge as these canals are located near the area to the east of TID where groundwater levels have steadily declined (see **Section 4.1.2**).

During the winters of 2006-2007 and 2007-2008, TID also lined approximately 4.5 miles of existing earthen canals for operational purposes. The main purpose of this project was to reduce maintenance requirements by preventing erosion, improving hydraulic efficiency, and reducing aquatic weed growth, with added benefits of seepage reduction. In 2014, TID converted the Lower Stevinson Flume to a pipeline. Additionally, Lateral 1 and Upper Lateral 4 have been converted from open channels to pipelines in some developed areas.

An effective lining maintenance program is necessary to prevent seepage losses from increasing due to cracks as the concrete lining ages. TID has an active gunite and canal lining maintenance program to maintain the effectiveness of the concrete lining. TID inspects canal lining on a regular basis and rates the lining condition by canal reach. Each year, lining condition and reach ratings are reviewed and reaches selected for resurfacing with gunite primarily based on the reach condition. Between 2000 and 2024, TID has resurfaced an average of approximately 340,000 square feet (7.8 acres, 0.012 square miles) of canal lining annually. In recent years (2020 and 2024), the annual average resurfaced area has been approximately 270,000 square feet. From time to time, TID has conducted ponding tests to quantify seepage rates in lined reaches to better understand the relationship between the canal reach rating system that is used to select reaches for maintenance, and the underlying soils and seepage of those reaches. The gunite and canal lining maintenance program helps to maintain hydraulic efficiency, prevent canal failure, and reduce seepage from the lined portions of the distribution system.

A substantial portion of the 700 miles of ID conveyance facilities have been replaced by pipeline systems. Aging or leaking pipelines are actively maintained and are replaced as necessary. TID provides low interest loans for these improvements (see **Section 7.4.3**).

7.4.5.2 Evaluation and Construction of Regulating Reservoirs

In addition to canal lining and pipeline conversion, TID has considered the construction of regulating reservoirs at key locations in the distribution system.

During the 2014-2015 winter season, TID constructed a regulating reservoir, referred to as the Lateral 8 Regulating Reservoir. The reservoir began operations in 2015 with 29 acre-feet of storage. The reservoir is located such that water which would normally be spilled from the Highline Canal or Lateral 8 can instead be routed to the new reservoir. TID expanded the storage capacity to 130 acre-feet in 2016 to allow more water to be captured.

In 2010, reservoirs on the Ceres Main Canal at the headings of Lower Lateral 3 and Lower Lateral 4 were evaluated as part of a phased project aimed at providing increased monitoring and control of the distribution system along with regulating storage to facilitate increased flexibility to growers and reduction of spills. Ultimately, the evaluation of the project including only the benefits to spill reduction resulted in a benefit-cost ratio of 0.23, denoting that local project benefits would provide only about one quarter of the cost required to implement the project at that time.

TID is currently working on a multi-year planning effort to improve irrigation service and modernize infrastructure, referred to as the TID Irrigation Facilities Master Plan (IFMP). The draft IFMP identifies and evaluates a suite of potential modernization projects for the District's water distribution infrastructure below Turlock Lake, including a variety of projects to construct regulating reservoirs and improve canal conveyance. Projects are being developed with the intent of allowing growers to adopt more efficient and productive on-farm irrigation systems, leading to increased water conservation over time as well as increased farm profitability. Projects have been conceptualized through input from TID staff at all levels and considering responses from 27 grower interviews that discussed existing and future cropping practices, irrigation systems, and water source preferences. The draft IFMP encompasses more than 50 work products, and will provide a strategic plan for future modernization of the TID system in the coming years. TID may potentially pursue select projects proposed in the draft IFMP, including regulating reservoir construction projects.

TID has completed construction of the 220 acre-foot Ceres Main Regulating Reservoir, adjacent to the confluence of the Ceres Main and Lower Lateral 3 Canals. The reservoir functions as a surface water regulating and storage facility, capturing operational fluctuations in the Ceres Main Canal during periods when supply exceeds demand and returning these flows back into the Ceres Main and Lower Lateral 3 Canals during water shortages. The facility improves drought resilience and supports water conservation through an anticipated average water savings of 10,000 acre-feet per year. In addition, the facility reduces groundwater pumping, improves water quality and operational flexibility, and improves customer service with more stable flows, increased water supply reliability and faster operations response times.

In addition, TID has finalized the design for the Lateral 5 ½ Reservoir and obtained CEQA clearance for its construction. TID plans to construct Lateral 5 ½ regulating reservoir in 2026, depending on funding.

Beyond constructing and studying new regulating reservoirs, TID has also conducted ponding tests at Turlock Lake as a means of evaluating existing reservoir operations. These tests have provided TID with more information about reservoir recharge to support efficient water management and to support decisions on future operations at Turlock Lake. TID has also implemented two pilot projects featuring solar panels installed over canal segments to generate renewable energy and reduce water evaporation. TID will evaluate the benefits and costs of these pilot projects over the next few years.

As described above, TID has implemented this EWMP in several ways through canal lining, canal maintenance, evaluation and construction of regulating reservoirs and innovative ways to reduce canal evaporation.. TID also assists IDs in doing the same. TID will continue these efforts in the future and will continue planning efforts to modernize the TID system, including the draft IFMP. Additionally, TID will continue to consider the construction of regulating reservoirs to increase distribution system flexibility and reduce operational spillage.

7.4.6 Increased Flexibility to Water Users (10608.48.c(6))

STATUS: IMPLEMENTING

TID is implementing this EWMP by providing arranged-frequency demand deliveries to its customers. TID has been a pioneer in providing increased flexibility to water users for decades, offering a wide range of flexibility in the frequency and duration of irrigation deliveries.

In TID's arranged-frequency demand ordering and delivery system, the irrigation frequency (day of irrigation) is arranged between TID and the customer through the water ordering process, the delivery flow rate is requested by the customer with some flexibility, and the delivery duration is controlled by the customer with complete flexibility (growers are allowed to irrigate until finished). On average, between 2011 and 2019 growers received water approximately 50 to 55 hours after they placed an order with the Central Call Center. From 2020 to 2024, the average wait time was 44 to 48 hours. In 2024, TID began using an earliest delivery date option for customers. Wait times for these orders are 18-24 hours. TID offers online customers to request an earliest available date. For these customer requests, the wait time averaged 18 hours in 2024. Approximately 10% of orders utilized this option in 2024.

TID has also taken several steps to provide increased levels of customer service. Prior to the start of the 2008 irrigation season, TID moved its Central Call Center to the TID Customer Service Department in order to improve customer service in taking water orders. In 2014, TID implemented online ordering and made water use information available online to growers. Growers can plan and manage water use on each parcel by requesting a copy of their water use records when placing a water order or at any other time of the year. At the end of each irrigation season, growers are also mailed a water use statement that details the number of irrigations, the amount of water applied during each irrigation, and total water use for the season. Additionally, TID provides customers with access to real time monitoring of Rubicon SlipMeters and permanent FlumeMeters.

TID continues to work to accommodate growers' evolving needs. Real-time SCADA monitoring of distribution system flows, water levels, and spillage by Water Distribution Operators (WDOs) has allowed TID to improve flexibility to water users while maintaining distribution system efficiency. In recent years, these improvements and efforts have allowed

TID to increasingly provide non-standard heads of water (i.e., less than 15 to 20 cfs) to customers who are using micro irrigation systems. In 2014, TID provided tablets to all WDOs and provided real-time access to SCADA sites, including nine miles of Rubicon Total Channel Control (TCC) automation provided by Rubicon SlipMeters and permanent FlumeMeters, as well as remote drainage pump controls. Intermediate system flows at several locations are also monitored to better manage canal operations to meet customer demands and prevent operational spillage.

During the 2014-2015 winter season, TID constructed a regulating reservoir to improve customer service on Lateral 8. The Lateral 8 Regulating Reservoir, as it is called, provided 29 acre-feet of storage beginning in 2015. The reservoir is located such that water which would normally be spilled from the Highline Canal or Lateral can instead be routed to the new reservoir, allowing WDOs to provide water with greater flexibility. The reservoir was so successful that TID expanded the storage capacity to 130 acre-feet in 2016 to allow more water to be captured.

In some dry years, TID allows growers to pump groundwater into the canals and then receive a delivery “credit” equal to the volume they supplied at any sidegate that serves their property. This practice supplements the water supply available to downstream users and allows growers the flexibility to transport water that they pump to any of their fields served by an active sidegate. The District implemented this practice in 2014-2015 and 2021-2022 and will consider implementing it again in future dry years.

In February 2019, TID completed an Irrigation Delivery Operations Assessment to evaluate the efficiency and flexibility of TID’s irrigation delivery system operations through (1) comparison of system parameters and deliveries between TID and other California irrigation water suppliers, and (2) evaluation of WDOs’ activities and roles in providing high-quality and flexible irrigation deliveries. The assessment found that overall TID ranks high among the water suppliers that were evaluated for their operational efficiency. During peak-season operations, TID’s WDOs provide, on average, the largest number of deliveries and the largest delivery volumes per hour worked among the suppliers that were compared. Observation and surveys of WDOs found that while TID’s policies to provide flexible irrigation deliveries to customers pose operational challenges and complicate delivery scheduling, TID’s WDOs are generally doing a good job of maintaining high operational efficiency.

Additionally, TID completed the Ceres Main Regulating Reservoir in 2023, which increases delivery flexibility for growers. The Ceres Main Regulating Reservoir captures flows from the Ceres Main Canal and then pumps the stored water back into the Ceres Main Canal and Lower Lateral 3 canal to enhance deliveries to the canal system downstream of the reservoir.

TID is currently working on a multi-year planning effort to improve irrigation service and modernize infrastructure, referred to as the TID Irrigation Facilities Master Plan (IFMP). As described in the previous section, the draft IFMP identifies and evaluates a suite of potential modernization projects for the District’s water distribution infrastructure, with the goal of maintaining and improving the level of irrigation service provided to its customers. This effort resulted in detailed project descriptions and implementation plans for a suite of potential projects to increase operational flexibility, among other benefits, while minimizing operational costs and life cycle costs of TID infrastructure. TID may potentially pursue select system modernization projects proposed in the draft IFMP.

TID has implemented numerous measures to increase flexibility in water ordering by, and delivery to, water users within operational limits, and will continue to implement locally cost-effective improvements consistent with this EWMP in the future.

7.4.7 Supplier Spill and Tailwater Recovery Systems (10608.48.c(7))

STATUS: IMPLEMENTING

TID is implementing this EWMP in several ways, through:

- Interception of spillage from upper laterals and Improvement District pipelines by the District’s canals, allowing water to be utilized to the greatest extent possible for deliveries downstream
- Spillage recovery from the Harding Drain
- Real time monitoring of distribution system spills
- Operation of drainage wells and rented wells to provide a localized source of supply and reduce spillage.

The District’s canal system is configured to intercept spillage from upper laterals and reuse this water to help meet irrigation demands in the lower laterals (see the District map in **Appendix D**). Additionally, some long Improvement District pipelines were designed and constructed to terminate at a TID canal, allowing recovery of undelivered irrigation water to be used for irrigation delivery downstream. This undelivered water generally originates from “fill up” and “run down” water (i.e., water that flows through the pipeline before and after deliveries, as the pipe first fills and then empties).

As described previously in **Section 7.4.2**, TID also recovers spillage from the Harding Drain for reuse along Lateral 5 ½. The Harding Drain is used to transport runoff, drainage from adjacent lands, groundwater accretions, and canal spillage. For the period from 2020 to 2024, an average of 1,860 AF of water per year was reused. There are also several private, grower-operated systems that recover a mixture of drainage water and operational spills to meet irrigation demands. The extent to which this occurs is not quantified as it occurs at the farm-level, downstream of the TID distribution system.

TID has completed the installation of SCADA monitoring equipment at its spillage sites and has upgraded these sites with float-operated sensors. The District has a total of 493 SCADA sites that monitor flows system-wide. Sites automatically transmit these data to master radios located at electrical substations, where these data are collected and transmitted over a fiber optic network to TID’s SCADA system. The District has largely accomplished the three main goals of its master SCADA plan:

- Maintain and upgrade the SCADA system to meet current and future needs.
- Create a centralized repository for water records and increase accessibility to SCADA data.
- Expand SCADA capabilities to incorporate cost-effective water operations and water delivery efficiency improvements.

TID has provided its WDOs with laptops to monitor the distribution system in real time, including all spillage sites. These remote monitoring capabilities enhance the ability of WDOs to minimize spillage while operating the distribution system flexibly and efficiently.

The SCADA system also supports spillage control by allowing WDOs to remotely control drainage pumps. Strategic pumping in the western portion of TID allows WDOs to tightly control flows along the downstream end of the distribution system. Under this operating regime, pumping is used to supplement irrigation deliveries low in the system. This reduces the volume of surface water that must be released from Turlock Lake and reduces the potential volume of spillage that could occur if surface water were used exclusively to satisfy these irrigation demands low in the system. Long travel times from Turlock Lake make it challenging for TID staff to respond to changing irrigation demands in the lower parts of the system while also minimizing operational spillage. Through the SCADA system, the WDOs can turn pumps on and off from their portable tablets, allowing them to respond much more quickly to changes in canal flows, and helping to further reduce spillage.

As described in **Section 7.4.5**, TID constructed a regulating reservoir, referred to as the Lateral 8 Regulating Reservoir, as part of a pilot installation of Total Channel Control (TCC) on Lateral 8. The reservoir is located such that water which would normally be spilled from the Highline Canal or Lateral 8 can instead be routed to the new reservoir. The reservoir began operating in 2015 with 29 acre-feet of storage and was expanded to 130 acre-feet in 2016. With TCC on Lateral 8, TID is also better able to match supply and demand and thus provide better service with increased flexibility to customers on Lateral 8 while simultaneously reducing spillage from Lateral 8.

TID has implemented and continues to operate spillage recovery, including spillage prevention measures at levels that are locally cost-effective. TID has also studied regulating reservoirs as an approach to spillage prevention and recovery. To that end, TID has purchased 7 acres at the end of Lower Lateral 2 which would enable a future reservoir and pump back system. Through its draft Irrigation Facilities Master Plan, described in **Section 7.4.5**, TID also conducted extensive evaluations of potential modernization projects that would improve system efficiency and reduce spillage. Among these potential projects are several potential reservoirs and a spillage recovery system. TID will continue to evaluate the cost-effectiveness of spillage and tailwater reduction opportunities in the future.

Recently in 2023, TID completed the Ceres Main Regulating Reservoir, which captures flows from the Ceres Main Canal and then pumps the stored water back into the Ceres Main Canal and Lower Lateral 3 canal. TID plans to construct Lateral 5 ½ regulating reservoir in 2026.

With regard to tailwater, most fields in TID that receive surface water are irrigated with basin check systems that produce no tailwater. Some tailwater is generated on the heavier soils of the northeastern portion of TID; however, most growers in this area have control structures to prevent irrigation tailwater from flowing back into the distribution system. Only a small volume of tailwater generated in the irrigation service area is intercepted by agricultural drains that flow into the distribution system. This water is blended with the water in the canals and delivered as irrigation water to the greatest extent possible. A survey of irrigated lands in 2004 indicated that only a small percentage of lands within TID (approximately 2,700 acres, or less than 2%) generate tailwater that ultimately enters the distribution system. An additional 8,200 acres in

TID can also produce tailwater, but this water does not enter the TID distribution system. Tailwater that does not enter the distribution system is available for recovery and reuse by growers within and outside of TID. TID also recovers and reuses tilewater that enters the District's distribution system. The tilewater is blended with surface water supplies from Don Pedro Reservoir and then utilized to the greatest extent possible for deliveries downstream.

7.4.8 Increase Planned Conjunctive Use (10608.48.c(8))

STATUS: IMPLEMENTING

The District is implementing increased planned conjunctive use of surface water and groundwater through a combination of actions as part of the District's overall conjunctive management strategy. TID's conjunctive management objectives include: 1) maintaining a sustainable groundwater system through continued use of surface water for deliveries and recharge in normal and wet years, and 2) maintaining water deliveries in dry years through increased groundwater pumping by the District and the growers.

On average, groundwater makes up approximately 15 percent of the TID and grower water supply in normal water supply years (2014-2024), and 36 percent of the TID and grower water supply in dry years (2014-2024). As a result, the use and recharge of groundwater supplies are an essential part of TID's water management program.

Key components of TID's conjunctive management program include the following:

- Competitive pricing to promote the use of available surface water supplies in all years.
- Higher-cost volumetric pricing in dry years to promote conservation of limited surface water supplies.
- Higher-cost volumetric pricing and higher-cost fixed charge per acre in dry years to provide revenue to operate drainage and rental wells required to pump additional groundwater.
- Direct and in-lieu recharge in wetter years through "replenishment" water sales to adjacent agricultural lands east of TID's irrigation service area.
- Operation of over 100 drainage wells to increase water supply and reduce spillage in the western service area.
- Utilization of rental wells to supplement available surface water supply, with an increase in the number of rented wells in dry years (up to 100 or more privately-owned wells).
- Use of treated wastewater for cooling at the Walnut Energy Center, as a substitute for groundwater.
- Partnership with the Eastside Water District for groundwater recharge projects.
- Implementation of groundwater monitoring as part of SGMA and SBx7-6 (California Statewide Groundwater Elevation Monitoring or CASGEM).
- Development of sophisticated groundwater and surface water models used as planning tools to aid conjunctive management, including a semi-automated water balance documenting surface water and groundwater use within the irrigation service area.
- Active participation in local groundwater management efforts, including the West Turlock Subbasin Groundwater Sustainability Agency (WTSGSA).
- Groundwater Recharge Assessment Tool (GRAT).

- GSP implementation including managed aquifer recharge projects.

Many of the key components of TID’s conjunctive management practices are described throughout this AWMP, including **Section 4.1.2.2** and **Section 3.5**, and have not been restated in detail within this section.

TID, as a member of the WTSGSA, adopted and began implementing the Turlock Subbasin Groundwater Sustainability Plan (GSP) in 2022. The GSP identifies actions needed to achieve groundwater sustainability in the Turlock Subbasin, providing support for ongoing conjunctive use of surface water and groundwater supplies in the Subbasin.

TID is identifying potential sites for two subsurface recharge pilot projects by evaluating land within the TID service area for subsurface recharge potential and suitability. Application of subsurface tile (perforated pipe) for recharge presents a new alternative practice to implement recharge activities on active farmland without impacting crop production. By leveraging subsurface recharge on orchards, TID can create a widespread infiltration network which would collectively be capable of recharging substantial volumes of water with minimal to no impact on surface land use.

As described in **Section 6**, TID actively forecasts runoff and manages its water supply through the Airborne Remote Sensing for Snowpack (ARSS) Program, Forecast-Coordinated Operations (F-CO) and Forecast-Informed Reservoir Operations (FIRO), and watershed monitoring programs. Data and tools available through these programs allow TID to better track and understand the amount of water in the upper watershed, informing reservoir operations to optimize the balance of available flood storage and water supply storage and to support conjunctive management decisions.

TID has also conducted ponding tests at Turlock Lake in recent years as a means of evaluating existing reservoir operations and groundwater recharge. These tests have provided TID with more information about reservoir recharge to support efficient water management and to support decisions on future operations at Turlock Lake. TID has initiated active recharge programs such as the Dianne Storm Basin, the TID On-Farm Recharge Project, and the Agricultural Recharge Project.

TID updated its water budget to include the Upper Main Canal and Turlock Lake. The TID water budget has historically been calculated only during the irrigation season for the distribution system and irrigated lands downstream of Turlock Lake, beginning with irrigation releases from Turlock Lake. Adding the Upper Main Canal and Turlock Lake to the water budget better accounts for all inflows and outflows of District supplies, including infiltration of surface water to the groundwater system. This information supports GSP implementation, helps TID staff to better quantify groundwater recharge, and directly supports conjunctive management decisions.

TID also plans to continue improving its monitoring and tracking of off-season flows through the system. In the past, TID has not operated the distribution system during the off-season except to pass storm flows, runoff, and drainage water through the service area. Measurement sites in the TID system have been monitored during the off-season primarily to observe changing trends in flow. Also, excess water has been passed through the system in some wet years using drainage outflow locations that are not part of the measured spillage network. As reporting needs change, TID will review its operations at these sites to ensure better accuracy throughout the entire water

year. Tracking these flows helps TID to manage this water better and to make use of it locally, supporting conjunctive use.

TID has a long history of leadership and optimization of conjunctive management in the Turlock Subbasin, with the objective to provide a reliable long-term water supply to growers in both normal and dry years. TID has implemented numerous locally cost-effective conjunctive management actions and will continue to evaluate and implement locally cost-effective actions consistent with this EWMP in the future.

7.4.9 Automate Canal Control Structures (10608.48.c(9))

STATUS: IMPLEMENTING

TID is implementing this EWMP by:

- Installing, operating, and maintaining more than 345 canal control structures that automatically control canal water levels or flows based on operator targets.
- Monitoring 493 SCADA sites in real time.
- Ensuring that all structure modifications allow for future automation.

TID has utilized automated canal control structures for over one hundred years. In particular, the District's 61 Meikle³² automatic gates, a type of hydraulic automatic gate believed to be unique to TID, provide water level control at check structures throughout the distribution system (Scobey, 1914) (**Figures 7.1 and 7.2**). The gates provide excellent water level control across a range of flows and require no external power.

Another “passive” structure utilized by TID to provide automatic control of canal water levels across a wide range of flows is the long crested weir. TID operates 227 long crested weirs throughout its distribution system. The long crested weir provides simple water level control through a triangular or rectangular weir (when viewed from above) that sits within the canal channel. Because of the relatively long crest over which water flows, relatively large fluctuations in flows over the weir result in relatively small fluctuations in the canal water level upstream of the weir. This allows for steady delivery of water to irrigation gates or lateral headings upstream of the weir.

Flap gates developed as a modified version of the Begemann gate by the Irrigation Training and Research Center (ITRC) at California Polytechnic State University, San Luis Obispo are also used at 18 locations within TID's distribution system. The flap gate provides automated water level control, serving the same function as a Meikle gate or a long crested weir, but with generally lower construction and installation costs. A disadvantage of flap gates is that they require a relatively large drop in water level across their control structures, limiting their applicability at many sites.

The District has also recently completed installing Rubicon FlumeGatesTM and SlipMetersTM at all canal head gate structures. These automatic gates can be set to control flow rates through them or water levels upstream of the control structure. These devices also have the benefit of

³² Named for Mr. Roy V. Meikle, who served the Turlock Irrigation District as chief engineer for over 50 years, beginning in 1912.

reporting flow rates to the District's SCADA control network and can be remotely operated through the network as well.

In addition to the automatic control structures described above, TID operates permanent and moveable Rubicon FlumeMeters™ throughout the District's service area. These gates are primarily used for delivery measurement. Additional Rubicon SlipMeters™ have also been installed to provide automated flow control and improved measurement accuracy for irrigation deliveries. These gates also report water levels through the SCADA system that are available to WDOs on their tablets, providing intermediate canal water level measurement sites where these gates are located throughout the system.

From Fall 2025 through the 2026 and 2027 Irrigation Seasons, TID will install and pilot a Level 5 Rubicon Total Channel Control (TCC) system on a stretch of the Ceres Main Canal from south of Keyes Road to Harding Road. The Rubicon TCC system will replace all manually operated gates, both side gates and drop structure gates, in the canal pilot stretch with automated Rubicon gates. These gates will open and close at scheduled irrigation times to maintain consistent and reliable flows to customers throughout their irrigations. The Ceres Main TCC pilot project will replace five long-crested overpour weirs with Rubicon Flume Gates. However, the new drop designs incorporate a backup long-crested spillway for emergency situations if needed. This project will also utilize five other drops that were modified in 2022 to incorporate Rubicon Flume Gates.

The Rubicon TCC system will also allow for more dynamic customer delivery scheduling while simultaneously preventing loss of water to operational spills. The project will improve 10 drop structures and 68 side gates serving 296 parcels totaling over 7,000 acres. The Rubicon TCC system will include a pilot of Rubicon's NeuroFlo online ordering and scheduling software, which will assist customers and TID operators in scheduling orders. The software will also provide real-time information and control capabilities, allowing the District to better meet customer needs. The expected benefits of this pilot program include: elimination of unintentional spills; increased water delivery reliability and consistency; faster access to irrigation water; reduced groundwater usage; improved water quality; and improved water accounting.

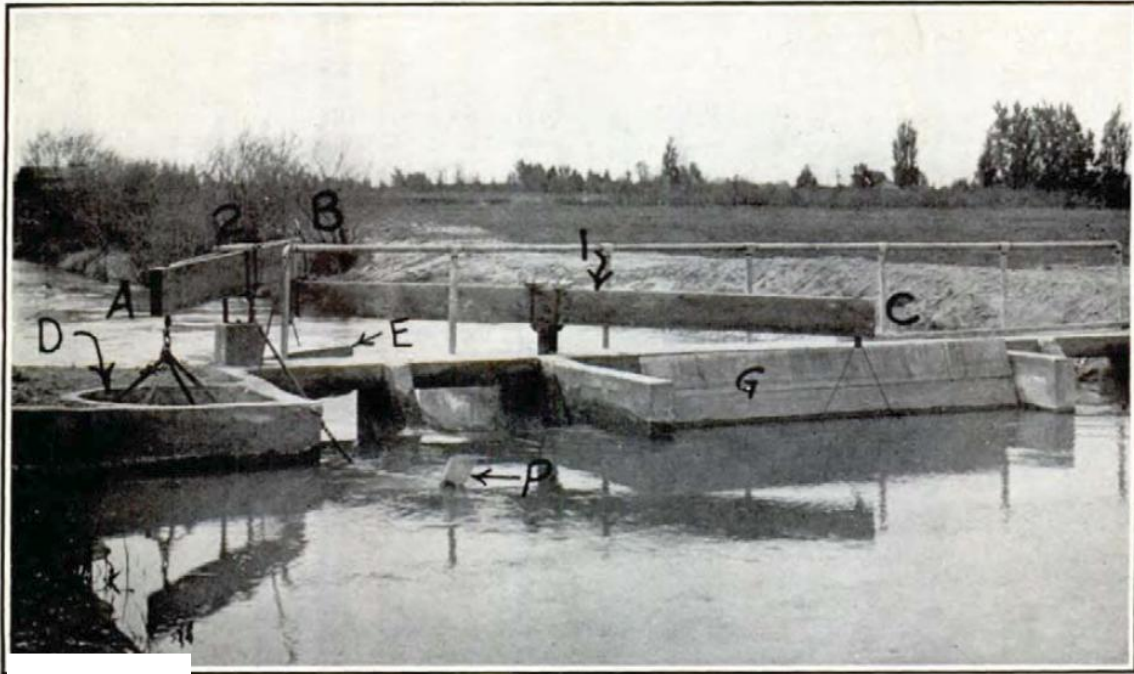


FIG. 1.—AUTOMATIC CHECK GATE, TURLOCK IRRIGATION DISTRICT, CALIFORNIA.

Figure 7.1. Photo of Meikle Automatic Gate (Source: Scobey, 1914).

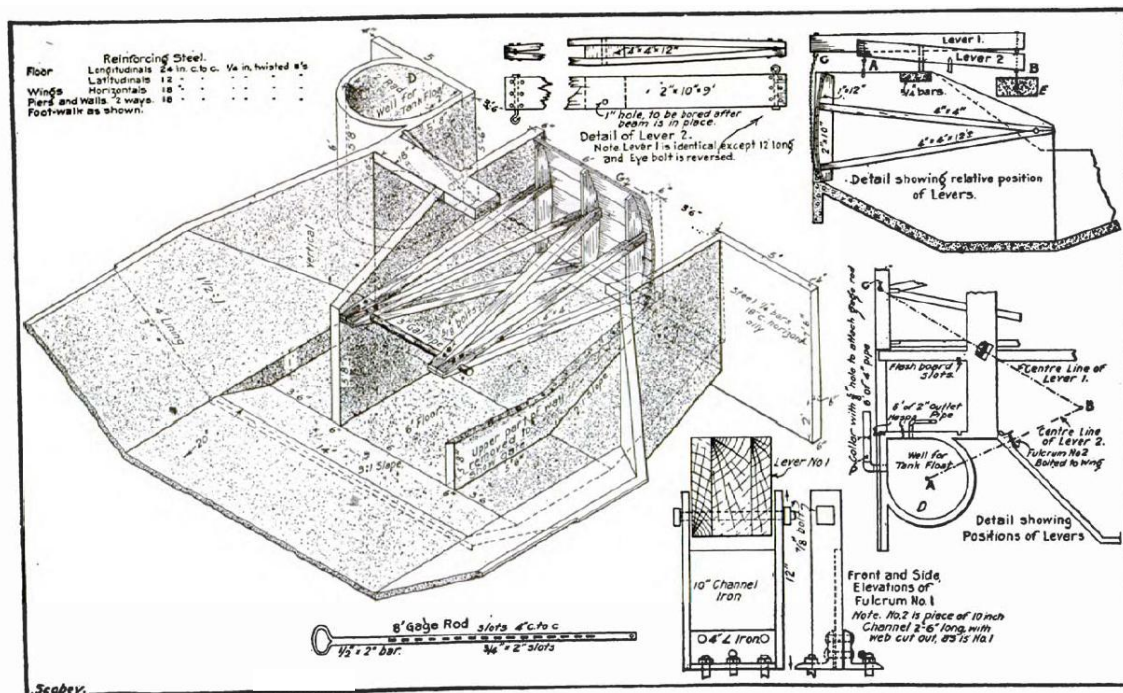


FIG. 14.—Automatic check drop on lateral of Turlock irrigation district.

Figure 7.2. Schematic of Meikle Automatic Gate (Source: Scobey, 1914).

Ongoing implementation of TID's Irrigation Capital Plan provides for automation and rehabilitation of canal control structures and drop structures as part of normal TID operations.

TID implements an ongoing maintenance program that is designed to ensure these automatic structures continue to operate effectively throughout the irrigation season. Regular canal inspections and coordination between WDOs and other field crews help TID to quickly identify maintenance issues and expedite repairs to ensure the facilities continue to operate as designed, maintaining reliable control of water levels.

In addition to the various automated structures used to operate the distribution system, TID has modernized its operations through the installation of 493 SCADA sites for real time water level and flow monitoring that help to optimize operation of the distribution system. Access to real time flow data allows WDOs to make more precise and timely adjustments to gates and control structures, as needed. Recent SCADA improvements have also provided WDOs the ability to remotely control drainage pumps using their portable tablets. As described in **Section 7.4.7**, TID plans to upgrade and expand its SCADA and automation opportunities in the future and has developed and is following a SCADA master plan.

TID has implemented and continues to operate a variety of automatic canal control structures that maintain water levels and flows in the distribution system. TID has also implemented a SCADA network that allows real time monitoring of canal levels by WDOs, improving the effectiveness of canal automation. TID will also continue to evaluate other cost-effective canal automation and modernization projects that would improve the ease and flexibility of distribution system operation while maintaining system efficiency.

7.4.10 Facilitate Customer Pump Testing (10608.48.c(10))

STATUS: IMPLEMENTING

TID is implementing this EWMP by conducting a pump testing program in which TID staff provide testing services for private pumps throughout the District's irrigation and electrical service areas.

As part of the pump testing program, TID trained employees in pump testing methods in 2014. Improvement District pumps and other privately owned pumps have historically been tested once per year when they are rented by TID, or upon request by the owner. TID has obtained portable Fuji flow meters for testing flows in pressurized pipe. These meters are used to test customers' wells upon request. Two staff members are available for water level testing and 12 WDOs are available for flow testing. The electrical service area includes approximately 40,000 additional cropped acres east of the irrigation service area that are irrigated almost exclusively with groundwater. Pump testing for this area is available through TID's electric department.

Over the last three to five years, pump testing has been limited as manpower has been redirected to other urgent efforts in support of TID's delivery measurement accuracy verification and field-testing program (described in **Section 7.2** and **Appendix F**).

TID plans to continue implementing the pump testing program in the future and will continue to evaluate locally cost-effective opportunities to expand the program as part of the District's overall management of water and electrical resources.

7.4.11 Designate Water Conservation Coordinator (10608.48.c(11))

STATUS: IMPLEMENTING

TID is implementing this EWMP by continuing to have a designated Water Conservation Coordinator to develop and implement the AWMP and encourage continued evaluation of efficient water management practices. This position was established in June 1997 and is currently filled by the District's Water Resources Analyst, Courtney Malmberg.

7.4.12 Provide for Availability of Water Management Services (10608.48.c(12))

STATUS: IMPLEMENTING

TID is implementing this EWMP through a variety of actions aimed at providing water management services to its customers. These actions are summarized in **Table 7.3** and the sections below.

Table 7.3. Summary of Water Management Services Provided to Irrigation Customers.

Water Management Service Category	TID Activities
On-farm irrigation and drainage system evaluations	Engineering design services for ID facilities
	Private and Improvement District pump testing upon request
Normal year and real-time irrigation scheduling and crop evapotranspiration information	Installation of CIMIS stations 168 (inactive) and 206 in Denair
	Link on TID web site to weather data from DWR CIMIS program and weather forecasts
	Contracted with Land IQ to receive monthly crop ET data
Surface water, groundwater, and drainage water quantity and quality data	Private and Improvement District pump testing upon request
	Water use information by parcel available from TID at any time online, or upon grower's request. All growers also receive a year-end water use report, and those who register an email address receive monthly irrigation summary reports via email.
	Information describing suitability of surface water, groundwater, and drain water quality for irrigation upon request
	Real time flows and storage for 6 surface water sites provided on TID website
	TID participates in DWR's CASGEM and SGMA groundwater level reporting program

Water Management Service Category	TID Activities
Agricultural water management educational programs and materials for farmers, staff, and the public	Grower newsletter distributed quarterly
	Monthly podcasts highlighting TID water management (https://www.tid.org/news-resources/podcast/)
	TID's Customer Academy is a free, five-week program aimed to engage and educate community members about TID's operations, offering a deeper understanding of our local irrigation water and power utility.
	TID has developed training videos for operation of Rubicon SlipMeters and posted them on its website.
	TID provides remote data access describing delivery flows for sidegates with SlipMeters and permanent FlumeMeters.
	Drought information page with extensive information to support on-farm water management during drought.
	TID employs an assistant engineer with a background in agriculture who provides on-farm technical support to growers. Services include support of micro/drip conversion and on-farm reservoir sizing.
	TID has expanded its use of new virtual communications mediums (social media, etc.) to enhance grower engagement
	Occasional seminars for growers on various water management topics

7.4.12.1 On-farm Irrigation and Drainage System Evaluations

TID is implementing on-farm irrigation system evaluations by offering pump tests to irrigators and Improvement Districts throughout the District's irrigation and electrical service areas. As described in **Section 7.4.10**, TID staff are trained in pump testing methods and provide flow tests upon request. Staff utilize Fuji flow meters for testing flows in pressurized pipes, allowing irrigators and owners to verify pump flow rates and application rates through their pressurized irrigation systems.

TID also supports IDs in building, operating, and maintaining on-farm water distribution systems, subsurface drain systems, deep wells, and micro irrigation systems. As described in **Section 7.4.3**, TID offers low interest financing to IDs, generally with a 10-year loan term, and offers engineering design and installation oversight for irrigation and drainage facilities. In addition, TID provides at-cost maintenance and repair for ID facilities.

7.4.12.2 Normal Year and Real-time Irrigation Scheduling and Crop Evapotranspiration Information

TID provides its customers with information on crop evapotranspiration and other parameters relevant to irrigation scheduling through the District's CIMIS station and website.

TID has been providing growers with local weather information to support on-farm water management for nearly 20 years. In early 2002, TID installed the California Irrigation Management Information System (CIMIS) Station #168 (Denair). The station was installed in a central location in the TID irrigation service area, providing data for a previously underrepresented area in the CIMIS network. In April 2009, CIMIS Station #168 (Denair) was relocated approximately two miles to the southeast and assigned a new station number (#206).

The station is currently located on an irrigated pasture with adequate fetch to provide reliable reference evapotranspiration estimates.

The station provides area-specific climate and reference evapotranspiration data to growers to allow them to effectively schedule irrigation events based on current and projected crop water usage. TID provides growers with the CIMIS website information and a web link to CIMIS tutorials and station data on the TID website (www.tid.org/irrigation/irrigation-information). The link to CIMIS on the District's website is shown in **Figure 7.3**. The District also provides links to additional information related to TID, reservoir and river conditions, drought resources, statewide conditions, and more on a Drought page on the TID web site (<https://www.tid.org/irrigation/drought/#drought-resources>; **Figure 7.4**). TID has also contracted with Land IQ to receive monthly crop ET data.

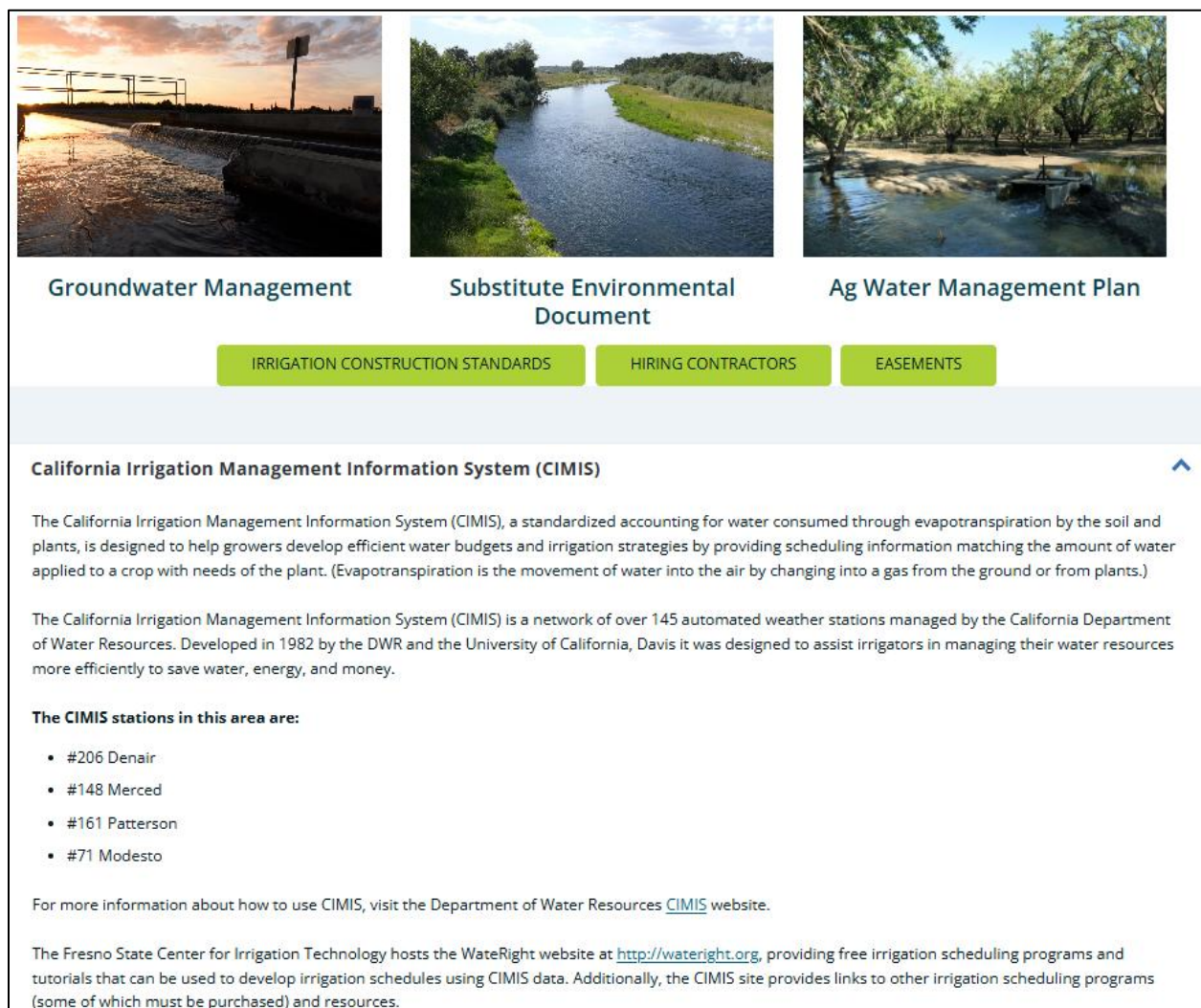


Figure 7.3. Link to CIMIS on TID Website.

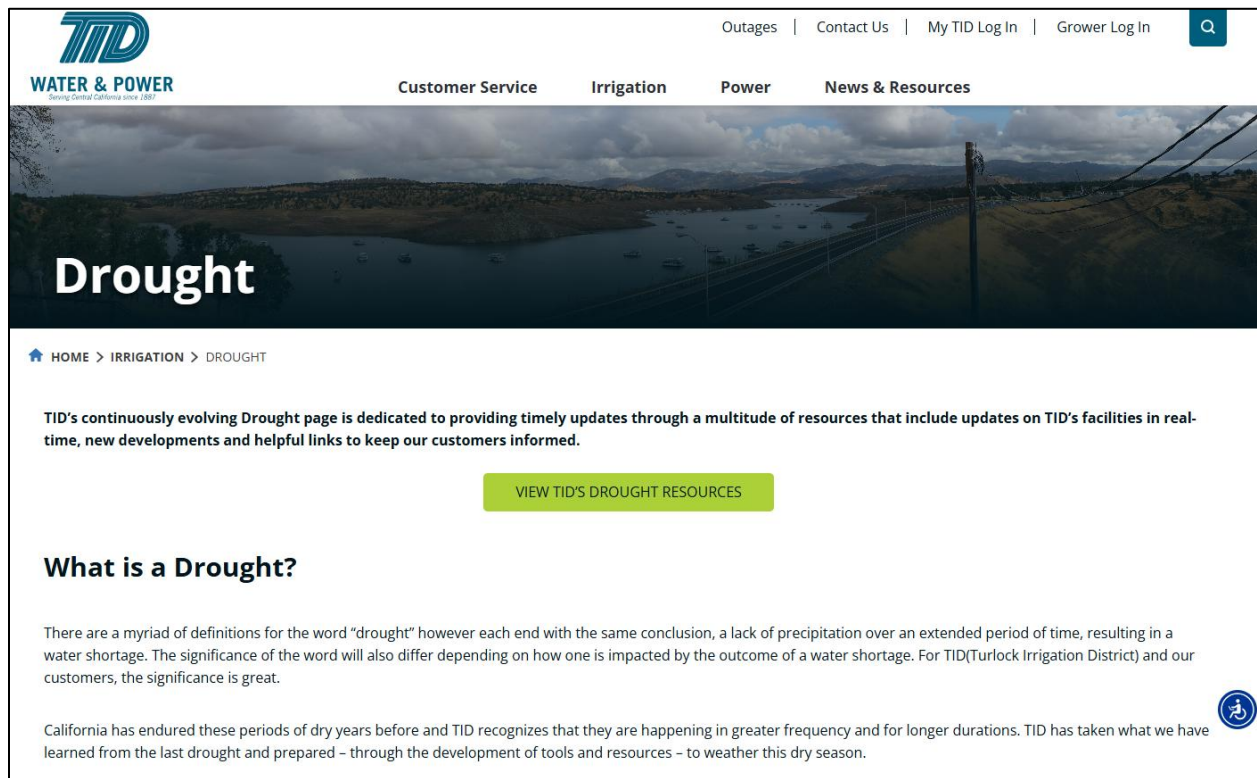


Figure 7.4. Additional Information on TID Website.

7.4.12.3 Surface Water, Groundwater, and Drainage Water Quantity and Quality Data

TID provides water use, water supply and water quality data to its irrigation customers through a variety of resources:

- Water use information is available by parcel from TID at any time online, or upon a grower's request.
- Water use information is provided by TID to all growers in a year-end water use report, and those who register an email address receive monthly irrigation summary reports via email.
- Real-time flows, water level, and storage are available on the TID website for various sites operated or used by TID (**Figure 7.5**):
 - Real-time flows, water level, and storage available for six sites via TID's Water Information Systems by KISTERS (WISKI) web portal (**Figure 7.6**, available at <https://www.tid.org/irrigation/reservoir-river-conditions/>).
 - Current report and link to current flows to the Tuolumne River below La Grange Dam (<https://www.cnrfc.noaa.gov/graphicalRVF.php?id=MDSC1>).
 - List of seven online telemetry gauges used by TID, with links to each on the USGS National Water Information System website.
- Groundwater monitoring is implemented by TID throughout the irrigation service area, a portion of which is reported for SGMA and as part of SBx7-6 (California Statewide Groundwater Elevation Monitoring or CASGEM) (**Figure 7.7**) Groundwater level data are available to growers upon request.
- Information about groundwater supply wells is provided by TID staff through pump tests. As described in **Section 7.4.10**, TID staff are trained in pump testing methods and provide flow tests upon request to irrigators and Improvement Districts throughout the District's irrigation and electrical service areas.
- Upper Tuolumne River watershed collaborative project to implement Forecast Informed Reservoir Operations (FIRO), a reservoir-operations forecasting strategy that is communicated to the TID Board of Directors, and available to the public through the Board process.
- Information describing the suitability of surface water, groundwater, and drain water quality for irrigation is collected by TID staff and is available to growers upon request, as described in **Section 4.2**:
 - Surface water quality is monitored at Main Canal Drop 1 (effectively representing Turlock Lake supply) and all spill locations twice during each irrigation season.
 - Groundwater samples from drainage wells and rented wells have historically been monitored to maintain a good understanding of the quality of groundwater entering the canal system. Samples are collected as needed to confirm the current water quality conditions if there are concerns regarding water quality in a specific area or from a particular well.
 - Groundwater samples are tested by TID during the formation of a pump Improvement District.

- Subsurface drainage at 32 tile drain discharge locations has historically been sampled and evaluated on a quarterly basis.
- Canal flows are monitored by multi-parameter water quality sondes at 18 canal and drain spill locations. The sondes measure electrical conductivity (EC) and temperature on a real-time basis, and upload the data into TID's SCADA system.

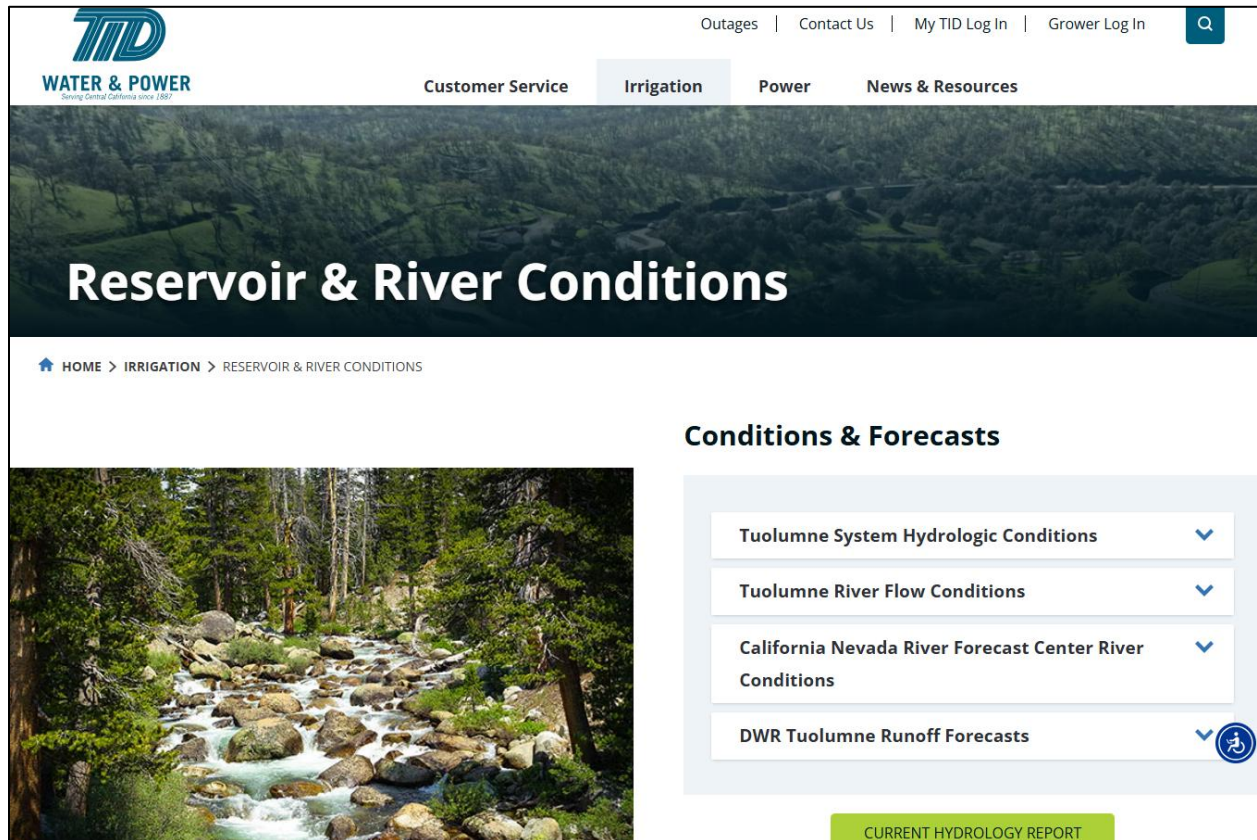


Figure 7.5. Links to Real Time Hydrological Conditions on TID Website
[\(https://www.tid.org/irrigation/hydrological-conditions/\)](https://www.tid.org/irrigation/hydrological-conditions/).

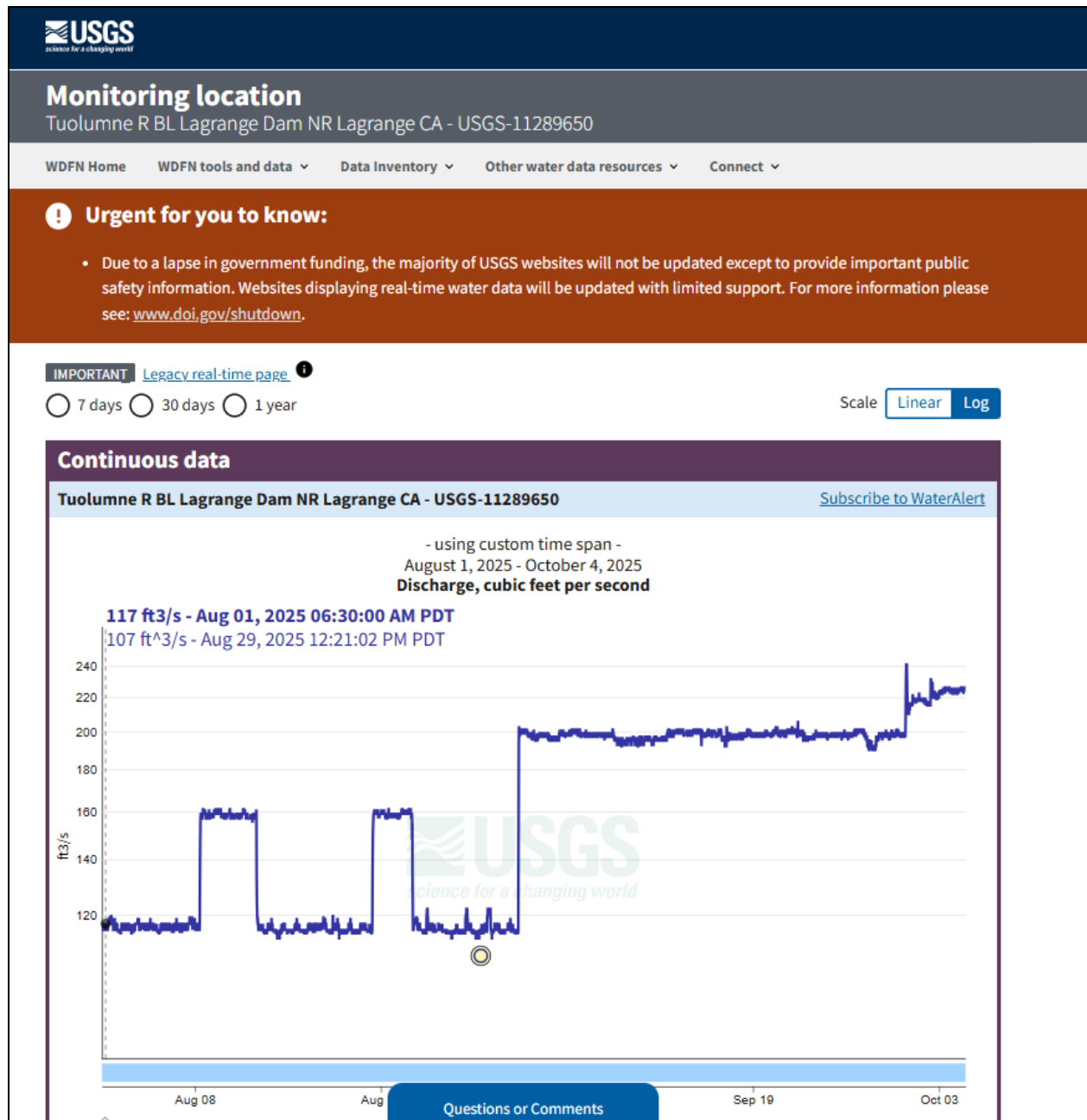


Figure 7.6. Sample Summary of Real Time Hydrological Conditions along Tuolumne River Below La Grange Dam.

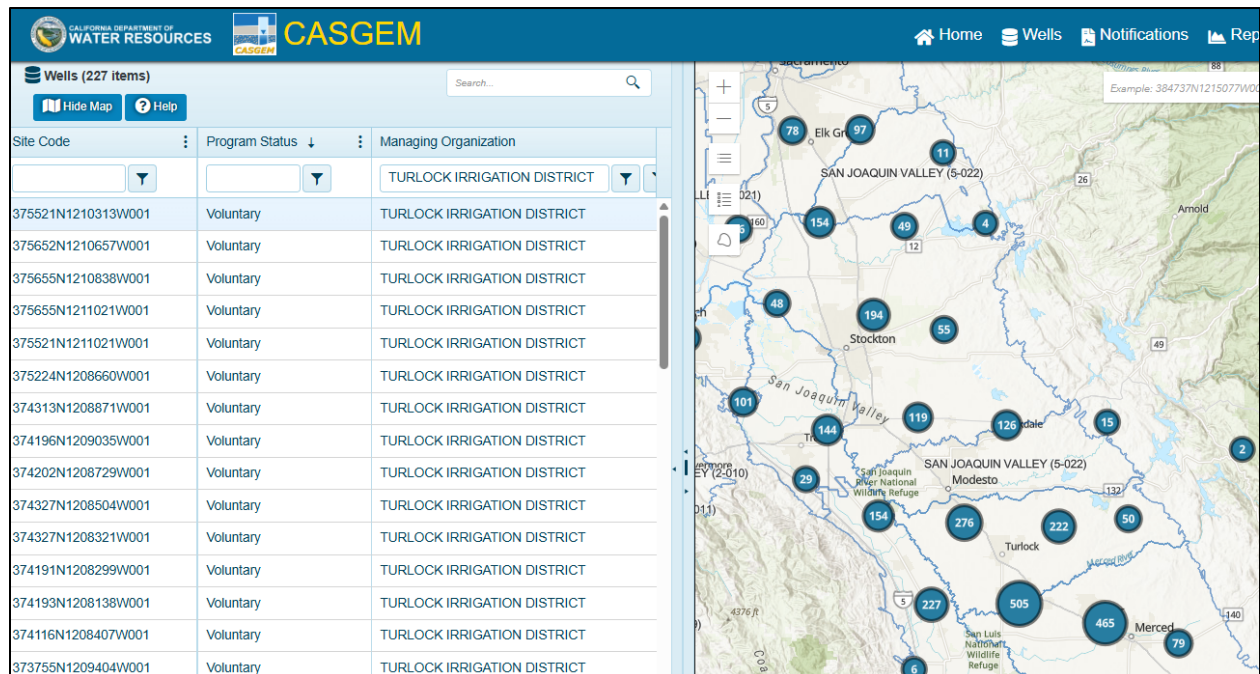


Figure 7.7. CASGEM Sites in the TID Service Area and Surrounding Areas.

7.4.12.4 Agricultural Water Management Educational Programs and Materials for Farmers, Staff, and the Public

TID offers numerous educational materials and programs to farmers, staff, and the public through its website, newsletter, social media, and other sources, as summarized below.

- TID regularly prepares an irrigation newsletter, titled “The Grower,” that is distributed to growers, staff, and the public quarterly (**Figure 7.8**).
- TID’s “Irrigation Information” webpage provides a wealth of resources and educational materials, all of which are provided in a user-friendly and accessible format (**Figure 7.9**). Topics and resources accessible on this page include (but are not limited to):
 - Irrigation tips for water conservation
 - Information on Rubicon gates
 - CIMIS weather station data
 - Water measurement educational resources
 - Groundwater management educational resources
 - TID’s most recently adopted AWMP and supporting documents
- TID’s “Irrigation” webpage provides links to educational materials and data from Don Pedro Reservoir, La Grange Dam, Turlock Lake, and other locations in the TID distribution system (see links to data in **Section 7.4.12.3**, and **Figure 7.5**).
- TID supports local educators by participating in school assemblies and demonstrations as well as career days and has created an “Education” webpage that provides education guides and videos to the public.
- TID has developed training videos for staff, irrigators, and growers that provide information on the operation of Rubicon sidegates. These videos are available in English

and Spanish on the TID website (<https://www.tid.org/irrigation/irrigation-information/rubicon-gates/>).

- TID provides remote data access to staff and growers, providing delivery flows data for sidegates with SlipMeters and permanent FlumeMeters.
- TID employs an assistant engineer with a background in agriculture who provides on-farm technical support to growers. Services include support of micro/drip conversion and on-farm reservoir sizing.
- TID has increased its social media presence, developing specific content to keep growers informed of the latest information.
- TID conducts occasional seminars for growers on various water management topics.
- TID has launched the *Water & Power Podcast*, a monthly series featuring conversations with industry experts and TID employees. Each episode explores key topics and insights related to water and power operations, discussing facts and important issues that shape the District's operations.

TURLOCK IRRIGATION DISTRICT

THE GROWER



WATER & POWER
Serving Central California since 1887



Grower Satisfaction Survey – We want your feedback!

TID is committed to providing exceptional customer service and upholding efficient operations that support the needs of our growers.

Now through September 15, 2025, TID will be conducting its first ever Grower Satisfaction Survey. The feedback you provide plays a critical role in helping us understand your needs and we hope you will take a few minutes to participate. Knowing what is most important to our growers will help us evaluate our current practices and help shape future improvements to services and operations.

SCAN HERE

to take the survey!



greatblue

SMART & TRUST

The information generated from the anonymous survey will inform TID of how to better serve your needs. Your input will impact how TID invests in infrastructure and technology and will contribute to improvements in service. Thank you in advance for providing insight as to how we can better fulfill our mission of delivering quality customer service and safe, reliable, and competitively priced irrigation water.

TID has partnered with research company GreatBlue to produce a survey that is easy to complete in 10 minutes or less. The survey will ask

your opinion on a variety of topics, like your satisfaction with TID's operations, the factors that influence your irrigation choices, your preferred methods of how to receive information from TID, and your level of interest in new programs like TID's Groundwater Recharge Program.

To take the survey or for additional information go to TID.org/GrowerSurvey.

IMPORTANT DATES

Last Day to Order Water:
Oct. 25

Last Day of Irrigation Season:
Oct. 29

REMINDER:

TID Offers Grower Online Access Training. Reserve your spot to access and walk through the Online Water Request System guided by a TID professional.

Workshops available on the following days:

Tue., August 19 at 8 a.m.
Wed., August 20 at 3 p.m.
Thu., August 21 at 5:30 p.m.

RSVP to reserve your spot at the workshop that fits your schedule. To RSVP for a workshop, please email TID at yivalencia@TID.org or call (209) 883-8357.

Figure 7.8. Front Page of August 2025 Issue of “The Grower.”

TID
WATER & POWER

Outages | Contact Us | My TID Log In | Grower Log In

Customer Service | **Irrigation** | Power | News & Resources

Irrigation Information

Links to facts, tips, irrigation management, and information on farming in a drought to help our growers be some of the most productive farmers in the world.

Links

Irrigation Tips | **TID Irrigation Rules** | **Rubicon Gates** | **Irrigation Season Resolution**

TID Irrigation Facts

- Irrigation service area: 307 square miles
- Irrigated acreage: 145,559 acres*
- Number of parcels: 7,500*
- Number of growers: 4,904*
- TID canals and laterals: 250 miles (90 percent concrete lined)
- Irrigation service boundary: The Sierra foothills on the east, the San Joaquin River to the west, the Tuolumne River to the north, and the Merced River to the south
- Predominant crops: Alfalfa, almonds, beans, corn, grain, grapes, oats, peaches, sweet potatoes and walnuts

*These figures fluctuate slightly from season to season.

Groundwater Management | **Substitute Environmental Document** | **Ag Water Management Plan**

IRRIGATION CONSTRUCTION STANDARDS | **HIRING CONTRACTORS** | **EASEMENTS**

California Irrigation Management Information System (CIMIS)

Water Measurement

Agricultural Discharges

Figure 7.9. TID Irrigation Information Webpage
(<https://www.tid.org/irrigation/irrigation-information/>).

7.4.13 Evaluate Supplier Policies to Allow More Flexible Deliveries and Storage (10608.48.c(13))

STATUS: IMPLEMENTING

TID is implementing this EWMP through ongoing partnership with cooperating entities at Don Pedro Reservoir, working together on watershed studies and other efforts, including Forecast-Coordinated Operations (F-CO) and Forecast-Informed Reservoir Operations (FIRO) of the reservoir. Data and tools available through these programs and the Airborne Remote Sensing for Snowpack (ARSS) Program allow TID to better track and understand the amount of water in the upper watershed, informing reservoir operations to optimize the balance of available flood storage and water supply storage. TID also works with applicable regulatory agencies that affect the flexibility with which TID can store and deliver water.

Another example of coordination is TID's role in the formation and ongoing operation of the West Turlock Subbasin Groundwater Sustainability Agency (WTSGSA), an association of local municipal water systems and agencies located in the western portion of the Turlock Subbasin. As a member of the WTSGSA, TID is actively involved in SGMA-implementation efforts and GSP development for the Turlock Subbasin, which may affect the flexibility of water use and storage in the Subbasin. TID will continue to evaluate opportunities for more flexible deliveries and storage in the future and will pursue those opportunities found to be locally cost-effective. TID will also maintain active involvement in SGMA implementation, GSP development, and GSP implementation in coordination with other agencies in the Turlock Subbasin.

7.4.14 Evaluate and Improve Efficiencies of Supplier's Pumps (10608.48.c(14))

STATUS: IMPLEMENTING

TID is implementing this EWMP by testing and monitoring TID-owned and privately-owned wells that the District rents.

In order to develop and maintain in-house pump testing capabilities, TID trained employees in pump testing methods. Pumps owned by TID are tested as needed to evaluate operational changes and to reliably calculate flows. The test results are used by staff to evaluate repair and replacement options. TID has an ongoing pump capital improvement program designed to maintain the efficiency of TID owned pumps through rehabilitation or replacement when necessary.

Improvement District pumps or other privately owned pumps have historically been tested once per year when they are rented by TID, or upon request by the owner. The pump test information has been utilized by TID to evaluate which pumps to rent and to accurately calculate the amount of water pumped by the District. This information is also provided to the pump owner to assist with maintenance decisions. Fewer pump tests have been conducted over the last three to five years as manpower has been redirected to other urgent efforts in support of TID's delivery measurement accuracy verification and field-testing program (described in **Section 7.2** and **Appendix F**).

TID has also implemented remote operation capabilities to improve the efficiency of the District’s drainage pumps. WDOs are able to remotely turn on and shut down drainage pumps using portable tablets to prevent operational spillage. This also reduces wear and tear on the pumps, prolonging the pump life and improving efficiency.

TID will continue to implement this program in the future and continue to evaluate locally cost-effective opportunities to expand the program as part of the District’s overall management of water and electrical resources.

7.5 SUMMARY OF EWMP IMPLEMENTATION STATUS

TID has taken many actions to promote efficient and sustainable water management throughout its more than 135-year history. Today, TID continues to review and plan additional measures to accomplish improved and more efficient water management. For purposes of this AWMP, TID’s actions have been organized and are reported with respect to the Efficient Water Management Practices (EWMPs) listed in Water Code §10608.48. A summary of the implementation status of each listed EWMP is provided in **Table 7.4**.

TID and its staff has long been active in, and affiliated with, organizations supporting excellence in water management, including the Association of California Water Agencies (ACWA), the California Farm Water Coalition (CFWC), the United States Committee for Irrigation and Drainage (USCID), the Irrigation Technology and Research Center (ITRC), the American Society of Civil Engineers (ASCE), the California Irrigation Institute (CII), the California Municipal Utilities Association (CMUA) and others. One of the benefits that TID’s active participation in these organizations brings is continuing exposure to water management innovations through conferences, trainings, and networking with water management professionals. Additionally, TID occasionally sends staff to water management trainings to enhance skill sets and increase basic understanding of efficient water management. TID will continue its engagement in the water management community, supporting water management advancements in the District, throughout California, and beyond.

Table 7.4. Summary of TID Implementation Status for EWMPs Listed Under CWC 10608.48(b) & (c).

Water Code Reference No.	EWMP	Implemented Activities (pre-2020 and ongoing)	Updates Since Last AWMP (2020-2025)	Planned Activities
Critical EWMPs				
10608.48.b(1)	Measure deliveries with sufficient accuracy	Initiated delivery measurement accuracy improvement program under a corrective action plan for SBx7-7 compliance: - Installed new permanent measurement devices with laboratory-certified flow rate accuracy at 142 sidegates serving roughly half the irrigated acreage in TID. - Developed calibrated flow rates at remaining sidegates for each specific combination of sidegate-parcel-irrigation method-requested flow rate: - Temporarily installed 129 mobile Rubicon FlumeMeters at 550 sidegates that serve 1,196 parcels (representing approximately 21 percent of TID) - Used Hach FH950 meters to determine parcel-specific calibrated flow rates at 349 sidegates serving 536 parcels (approximately 13 percent of TID) - Used Fuji Portaflow meters to determine parcel-specific calibrated flow rates at 471 sidegates serving 877 parcels (approximately 19 percent of TID) - Completed initial corrective action plan goals, providing direct measurements or calibrated delivery flow rates to 100% of the assessed acreage served by active, non-exempted sidegates - Updated water ordering, delivery, and billing software to use the measured and calibrated flow rates for billing. - Used updated values to calculate the measured volume of water delivered for reporting to DWR. - Conducted a formal certification of the volumetric measurement accuracy consistent with 23 CCR §597. - Verified accuracy of new permanent measurement devices. - Verified accuracy of existing measurement devices (progress delayed due to operational challenges associated with COVID-19)	- Completed the last remaining actions needed for formal certification of the volumetric measurement accuracy of existing measurement devices, consistent with 23 CCR §597. - Verified accuracy of existing measurement devices that had not yet been field-tested and certified. - Continued using the measured and calibrated flow rates for billing. - Continued using the measured and calibrated flow rates to calculate the measured volume of water delivered for reporting to DWR. - Continued flow rate calibrations in response to evolving needs of customers. - Considering additional permanent measurement devices when funding is available and where it provides benefits (e.g., measurement accuracy and/or customer service improvements).	- Continue using the measured and calibrated flow rates for billing. - Continue using the measured and calibrated flow rates to calculate the measured volume of water delivered for reporting to DWR. - Continue flow rate calibrations in response to evolving needs of customers. - Consider additional permanent measurement devices when funding is available and where it provides benefits (e.g., measurement accuracy and/or customer service improvements).
10608.48.b(2)	Adopt a water pricing structure based in part on quantity delivered	Tiered pricing structure based on volume of water delivered (in effect since 2013; current rate structure in effect since 2015 after completion of the Proposition 218 process) Updated water ordering, delivery, and billing software to use the measured and calibrated flow rates (described under 10608.48.b(1)) for billing.	Updated tiered volumetric pricing structure with new structure and prices effective in 2025, after completion of the Proposition 218 process.	Continue implementing a tiered volumetric pricing structure, although the price will likely change over time. Continue using measured delivered volume and calibrated flow rates from EWMP 1 for billing.
Conditional EWMPs				
10608.48.c(1)	Facilitate alternative land use (lands with exceptionally high water duties, or lands that contribute to significant problems, e.g. drainage)	Not Technically Feasible (not an issue in TID – lands with exceptionally high water duties or significant problems do not exist in TID’s service area; Irrigation Rules prohibit wasteful use, precluding exceptional water duties or significant problems)	No change (Not Technically Feasible)	No change (Not Technically Feasible)
10608.48.c(2)	Facilitate recycled water use	- Dairy nutrient water and industrial process water from Hilmar Cheese is recycled and applied to TID irrigated lands. - Treated M&I water is recycled and applied to TID irrigated lands. - Spillage recovery and tilewater/tailwater flow into canals, where this water is available for reuse downstream. - Active spillage recovery from Harding Drain - Tertiary treated effluent from City of Turlock used for cooling at TID’s Walnut Energy Center	- Continued existing use of recycled water within TID service area, as listed in the previous column. 4,690 AF/year (2020-2024 average) combined reuse from M&I wastewater, dairy nutrient water, and Hilmar Cheese 1,860 AF/year (2020-2024 average) spillage recovery from Harding Drain 8,350 AF/yr (2020-2024 average) combined tilewater and tailwater into canals	- Continue existing use of recycled water within TID. - Plan to begin using recycled “offset” water from SRWA in the next five years - Continue working with cities and qualifying permitted dischargers to gain access to recycled water supplies.

Water Code Reference No.	EWMP	Implemented Activities (pre-2020 and ongoing)	Updates Since Last AWMP (2020-2025)	Planned Activities
		Completed Water Sales Agreement with SRWA in July 2015, with the provision that the SRWA will provide additional “offset” water to TID from recycled or stored groundwater supplies in exchange for surface water supplies from TID.	- Have continued using recycled water for cooling at Walnut Energy Center (1,000 AF/year) - Regional Surface Water Supply Project completed in 2023.	
10608.48.c(3)	Facilitate financing of capital improvements for on-farm irrigation systems	- TID has an active financing program for IDs, which support on-farm capital improvements (low interest financing, 10-yr loan term) - Offers engineering design and construction oversight for ID irrigation facilities. - Offers at-cost maintenance and repair of ID irrigation facilities (assessment process) - Pursues grant funding to assist growers with on-farm improvements (WaterSMART, etc.) - Hired assistant engineer with a background in agriculture whose primary duty is to provide on-farm technical support and design assistance to TID customers (e.g., micro/drip conversion and on-farm reservoir sizing)	- Continued offering existing programs and services, as listed in the previous column. - Continued searching for grant funding, including those to support on-farm improvements. - Adopted Turlock Subbasin GSP, which includes projects that facilitate on-farm improvements that encourage continued use of surface water (On-Farm Recharge Project (in WTSGSA))	- Continue offering existing programs and services. - Continue searching for grant funding, including those to support on-farm improvements. - Implement GSP projects that facilitate on-farm improvements that encourage continued use of surface water. - Work with growers to test subsurface recharge.
10608.48.c(4)	Implement an incentive pricing structure that promotes one or more of the following: (A) More efficient farm water use, (B) Conjunctive use, (C) Groundwater recharge, (D) Reduction in problem drainage, (E) Environmental resources management, (F) Effective management of all water sources throughout the year by adjusting seasonal pricing structures based on current conditions.	Tiered pricing structure promotes (A), (B), (C), and (F). Rates are higher with higher water use, promoting efficiency (A). Normal/dry year rates help to manage water by adjusting rates to reflect current water conditions (F) and by supporting TID’s conjunctive management strategy (B). Lower rates in normal years encourage recharge (C).	- Continued using tiered volumetric pricing structure, as listed in the previous column. - Updated tiered volumetric pricing structure with new structure and prices effective in 2025, after completion of the Proposition 218 process.	Continue implementing a tiered volumetric pricing structure, although the price will likely change over time.
10608.48.c(5)	Expand lining/piping of distribution systems, and construct regulatory reservoirs	Lining/Pipelines: - Lined or converted to pipelines in 92% percent of the distribution system downstream of La Grange Diversion Dam (222 miles out of ~240 miles). - In 2006-2008, lined ~4.5 miles of earthen canals. - In 2014, converted the Lower Stevinson Flume to a pipeline. - Lateral 1 and Upper Lateral 4 have been converted from open channels to pipelines in some developed areas. - Active gunite and lining maintenance program (~340,000 square feet of canal lining resurfaced each year (7.8 acres, or 0.012 square miles)) - Ponding tests conducted to quantify seepage rates in lined reaches. - Substantial portion of the 700 miles of ID conveyance facilities have been replaced by pipeline systems, with maintenance and replacement of aging or leaking pipes as needed. Regulating Reservoirs: - In 2015, TID completed the Lateral 8 Regulating Reservoir integrated with TCC on Lateral 8	- Continued gunite and lining maintenance program (~340,000 square feet of canal lining resurfaced each year (7.8 acres, or 0.012 square miles)) - Completed Ceres Main Canal Reservoir. - Completed design of the Lateral 5 ½ reservoir. - Obtained CEQA clearance to construct the Lateral 5 ½ regulating reservoir. - Completed two pilot projects with solar panels covering portions of canals to generate renewable energy and reduce evaporation	- Continue gunite and lining maintenance program. - Continue existing programs and efforts. - Potentially pursue select TID system modernization projects to be proposed in Draft IFMP, including regulating reservoir construction projects - Upon completion of GSP, there could be other GSP modernization projects that work in combination or in concert with other TID projects, including the Draft IFMP projects - Planning to construct Lateral 5 ½ regulating reservoir in 2026, depending on funding. - Evaluate two pilot projects with solar panels covering portions of canals to generate renewable energy and reduce evaporation

Water Code Reference No.	EWMP	Implemented Activities (pre-2020 and ongoing)	Updates Since Last AWMP (2020-2025)	Planned Activities
		- Expanded storage capacity of Lateral 8 Regulating Reservoir to 130 acre-feet in 2016 to allow more water to be regulated. - Completed Draft Irrigation Facilities Master Plan (IFMP), identifying, evaluating, ranking, and creating implementation strategies for potential distribution system modernization projects, including a variety of projects to potentially construct regulating reservoirs and improve canal conveyance. - Acquired land for a new regulating reservoir site, began design and began preparation of an Initial Study in accordance with CEQA for the new regulating reservoir. - Conducted ponding tests at Turlock Lake as a means of evaluating existing reservoir operations, providing information about reservoir recharge to support efficient water management and to support decisions on future operations at Turlock Lake - Feasibility studies of reservoirs on the Ceres Main Canal		
10608.48.c(6)	Increase flexibility in water ordering by, and delivery to, water customers	- Expanded customers’ ability to request and receive non-standard delivery flows to serve drip and microirrigation systems (standard flood head is 15 cfs) - Continued offering existing benefits to customers: - arranged-frequency demand deliveries - online ordering and online water use information - annual water use statement - access to real-time monitoring data - Continued operating and installing SCADA equipment to improve operational flexibility. - Completed Irrigation Delivery Operations Assessment in 2019 to evaluate the efficiency and flexibility of TID’s irrigation delivery system operation. - Compared parameters related to system flexibility, efficiency, and deliveries between TID and other California irrigation water suppliers. - Evaluated WDOs’ activities and roles in providing high-quality and flexible irrigation deliveries. - Completed Draft IFMP, creating a strategic plan and cost estimates for modernizing the TID system and infrastructure. These projects are conceptualized and designed with the goal of improving service levels, including delivery flexibility and consistency, to TID’s customers. - In 2015, allowed growers to pump groundwater into canals in exchange for a delivery “credit” of equal volume - TID offers arranged-frequency demand deliveries (arranged day; requested delivery flow rate; duration is controlled by customer) - Improvements to customer service - Central Call Center moved to Customer Service Department (2008) - Online ordering and online water use information (since 2014) - Water use information available upon request at any time; all growers are mailed annual water use statement (number/volume of irrigations, total water use), and those who register an email address receive monthly irrigation summary reports - Access to real-time monitoring from SlipMeters and FlumeMeters - Distribution system infrastructure improvements and monitoring allow WDOs greater flexibility in operating the system (giving them, in turn, greater flexibility to provide deliveries of various flow rates to growers) - SCADA equipment - real-time monitoring of flows, water levels, spillage, and intermediate system flows, and remote control of	- Continued offering existing benefits to customers: - arranged-frequency demand deliveries - online ordering and online water use information - annual water use statement - monthly irrigation summary reports (registered email address) - access to real-time monitoring data - Continued operating and installing SCADA equipment to improve operational flexibility. - In 2024, the District began using an earliest delivery date option for customers. Wait times for these orders are 18-24 hours compared to 44-48 hours for all orders - Ceres Main Regulating Reservoir completed; increases delivery flexibility for growers.	- Continue offering existing benefits to customers: - arranged-frequency demand deliveries - online ordering and online water use information - annual water use statement - monthly irrigation summary reports (registered email address) - access to real-time monitoring data - in some dry years, allow growers to pump into canals for a delivery “credit” of equal volume. - Plan to continue offering non-standard delivery flows to customers, and providing flow rate calibrations in response to evolving customer needs - Continue operating and maintaining SCADA equipment and controls that allow WDOs to improve operational flexibility. - Potentially pursue select TID system modernization projects proposed under Draft IFMP.

Water Code Reference No.	EWMP	Implemented Activities (pre-2020 and ongoing)	Updates Since Last AWMP (2020-2025)	Planned Activities
		drainage pump to better meet customer demands and prevent operational spillage. ○ Lateral 8 Regulating Reservoir and TCC Project (in operation since 2015) • In some dry years (e.g., 2014-2015), TID allows growers to pump groundwater into canals and receive a delivery “credit” of equal volume. This practice supplements the water supply available to downstream users, and allows growers the flexibility to transport water that they pump to any of their fields served by an active sidegate.		
10608.48.c(7)	Construct and operate supplier spill and tailwater recovery systems	• WDOs have continued remote monitoring of spillage sites using SCADA, and remote operation of drainage wells to reduce spillage. • Continued interception and recovery of spillage and excess water in the TID system, utilizing this water to the greatest extent possible for deliveries downstream. • Expanded capacity of Lateral 8 Regulating Reservoir to 130 acre-feet in 2016, increasing the storage of excess flows and water that would have otherwise spilled from Lateral 8 and the Highline Canal • Ongoing implementation of the SCADA Master Plan TID; canals passively intercept spillage from the upper laterals allowing water to be utilized to the greatest extent possible for deliveries downstream. • TID system intercepts undelivered irrigation water from ID pipelines • TID system recovers and reuses tilewater and tailwater that re-enter system. • Spillage is actively recovered from Harding Drain. • Lateral 8 Regulating Reservoir and TCC project regulates excess flows and reduces spillage from Lateral 8 • WDOs use tablets and computers in the field to access real-time SCADA data at spillage sites and other locations in the system, allowing better control over the system to reduce spillage. • Operation of drainage wells (many of which are remotely-operable) and rented wells to provide a localized source of supply to match demand and reduce spillage. • Created and implemented SCADA Master Plan, which has helped to reduce spillage through increased mobile data access, remote operation and monitoring of irrigation control structures, and improved system redundancy	• Continued interception and recovery of spillage and excess water in the TID system, utilizing this water to the greatest extent possible for deliveries downstream. • WDOs have continued remote monitoring of spillage sites using SCADA, and remote operation of drainage wells to reduce spillage. • Ceres Main Canal Reservoir was completed.	• Plan to continue operation of distribution system and SCADA to recover and reduce spillage. • Planning to implement canal modernization projects to reduce spillage and increase delivery flexibility • Planning to construct Lateral 5 ½ regulating reservoir in 2026
10608.48.c(8)	Increase planned conjunctive use of surface water and groundwater within the supplier service area	• Continued conjunctive management program. • Enhanced conjunctive management by modifying operations to pump even less in normal and wetter years to further increase the use of available surface water and allow for in-lieu groundwater recharge, with lower rented pumping on average in the last five years as compared to the historical past. • Continued remote operation of drainage wells to carefully control pumping and increase groundwater recharge. • Active participation in local groundwater entities and initiatives, including SGMA efforts. • Active engagement in the development of a groundwater recharge assessment tool (GRAT) for the Turlock Subbasin • Conducted ponding tests at Turlock Lake as a means of evaluating existing reservoir operations, providing information about reservoir recharge to support efficient water management and to support decisions on future operations at Turlock Lake. • TID implements a comprehensive conjunctive management program in its regular operations.	• Continued conjunctive management program. • Enhanced conjunctive management by modifying operations to pump even less in normal and wetter years to further increase the use of available surface water and allow for in-lieu groundwater recharge, with lower rented pumping on average in the last five years as compared to the historical past. • Continued remote operation of drainage wells to carefully control pumping and increase groundwater recharge. • Improved monitoring and tracking of off-season flows through the system, supporting better management of this water and the District’s ability to make use of this water locally. • Adopted Turlock Subbasin GSP. • Active participation in local groundwater entities and initiatives, including SGMA efforts. • Active engagement in the development of the groundwater recharge assessment tool for the Turlock Subbasin	• Plan to enhance conjunctive management program and related practices. • As a member of the West Turlock Subbasin GSA, adopt and begin implementing the Turlock Subbasin Groundwater Sustainability Plan (GSP), with plans to achieve groundwater sustainability by 2042. • Continue the recharge programs and implementation of the Turlock Subbasin GSP. • Continue expanding groundwater monitoring under SGMA. • Continue engagement in the development and application of a groundwater recharge assessment tool (GRAT) for the Turlock Subbasin. • Continue active runoff forecasting and surface water supply management through the ARSS, F-CO, FIRO, and watershed monitoring programs. • Improve monitoring and tracking of off-season flows through the system, supporting better management of

Water Code Reference No.	EWMP	Implemented Activities (pre-2020 and ongoing)	Updates Since Last AWMP (2020-2025)	Planned Activities
		- TID has a series of pre- and post-1914 water rights that provide secure surface water supplies. - In dry years, TID operates drainage wells and rents privately-owned wells to increase water supply. - Tiered pricing structure in normal and dry years - Affordable pricing to promote the use of available surface water supplies in all years. - Lower volumetric prices in normal years to incentivize surface water use and recharge. - Higher volumetric prices and fixed charges in dry years to promote water conservation and to provide revenue to operate drainage and rented wells required to pump additional groundwater. - In certain wet years when sufficient water is available, TID promotes direct and in-lieu recharge through “replenishment water” sales within the Subbasin but outside of the TID service area. - Use of treated wastewater for cooling at the Walnut Energy Center, as a substitute for groundwater - Implementation of groundwater monitoring as part of CASGEM. - Development of sophisticated groundwater and surface water models to support long term conjunctive use planning and management. - TID actively forecasts runoff and manages surface water supply through ARSS, F-CO, FIRO, and watershed monitoring programs.	- Continued active runoff forecasting and surface water supply management through the ARSS, F-CO, FIRO, and watershed monitoring programs. - Initiated active recharge programs - Diane Storm Basin - TID On-Farm Recharge Project - Agricultural Recharge Project - Updated water budget to include the Upper Main Canal and Turlock Lake, supporting better accounting for all inflows/outflows, including recharge.	this water and the District’s ability to make use of this water locally.
10608.48.c(9)	Automate canal control structures	- Continued operation of existing automatic canal control structures and SCADA sites - Installing 72 Rubicon gates. - Completed Draft IFMP, creating a strategic plan and cost estimates for modernizing the TID system and infrastructure, including canal system automation projects. - Ongoing implementation of TID’s Irrigation Capital Plan, which provides for automation and rehabilitation of canal control structures (drop structures, etc.) as part of normal TID operations. - TID operates more than 345 automatic canal control structures, including 61 Meikle automatic gates, 227 long-crested weirs, flap gates (18 locations), Rubicon FlumeGates™ (72 locations), and other structures. - TID has been installing Rubicon FlumeGates and SlipMeters at many canal head gate structures, with SCADA integration and remote operability. - Created and implemented SCADA Master Plan, and now operates 397 SCADA sites, providing control and/or real-time flow and water level information throughout the canals, including at lateral headgates. - All structure modifications are designed to allow for future modification. - Lateral 8 Regulating Reservoir and Total Channel Control (TCC) implemented on Lateral 8 beginning in 2015, allowing near-full automated control of flows along Lateral 8.	- Continued operation of existing automatic canal control structures and SCADA sites - Installed 129 new Rubicon gates, now at 72 locations in the distribution. - Ongoing implementation of TID’s Irrigation Capital Plan, which provides for automation and rehabilitation of canal control structures (drop structures, etc.) as part of normal TID operations. - Implemented SCADA Master Plan, and now operates 493 SCADA sites, providing control and/or real-time flow and water level information throughout the canals, including at lateral headgates (all lateral headings now have a Rubicon gate controlling flow).	- Continue operating existing automatic canal control structures and SCADA sites. - Continue installing Rubicon gates. - Consider pursuing select canal automation modernization projects. - Ongoing implementation of TID’s Irrigation Capital Plan, which provides for automation and rehabilitation of canal control structures (drop structures, etc.) as part of normal TID operations. - Continue to review delivery measurement accuracy and customer needs and consider if additional permanent flow measurement devices should be installed. - Ceres Main TCC Pilot Project to test Rubicon full canal and delivery automation
10608.48.c(10)	Facilitate or promote customer pump testing and evaluation	- TID conducts a pump testing program and provides testing services for private pumps upon request throughout the District’s irrigation and electrical service areas. - TID historically tested rented pumps once per year. - TID uses portable flow meters to test customer wells. Two staff members are available for water level testing and twelve WDOs plus additional staff are available for flow testing. - TID trained employees in pump testing methods	Continued pump testing program for District-owned and rented pumps, and offering pump testing services for private pumps upon request (fewer tests over last 3-5 years as manpower has been redirected to delivery measurement accuracy field-testing efforts)	Continue pump testing program and offering pump testing services

Water Code Reference No.	EWMP	Implemented Activities (pre-2020 and ongoing)	Updates Since Last AWMP (2020-2025)	Planned Activities
10608.48.c(11)	Designate a water conservation coordinator	- Water Conservation Coordinator position established in 1997. - Position is currently filled by the District’s Water Planning Department Manager	Appointed a Water Conservation Coordinator in 2025 (Courtney Malmberg)	Continue employment of a Water Conservation Coordinator.
10608.48.c(12)	Provide for the availability of water management services to water users.	On-farm irrigation and drainage system evaluations: - TID provides services to build, operate, and maintain improvement district (ID) facilities, including on-farm distribution and irrigation facilities, subsurface drains, and deep wells. - TID staff provide testing upon request for pump flow rates and application rates through pressurized irrigation systems using Fuji flow meters. Normal Year and Real-time Irrigation Scheduling and Crop Evapotranspiration Information - TID installed CIMIS stations #168 (now inactive) and #168 at Denair in 2002 and 2009. - TID provides growers with CIMIS website information, tutorials, and data through links on the TID irrigation information web page. - TID provides growers with weather and precipitation forecasts on the TID weather web page. Surface water, groundwater, and drainage water quantity and quality data: - Parcel water use information available at any time online, or upon a grower’s request - Water use information provided to all growers in year-end water use report. - Real time flows, water level, and storage are available on the TID website for various sites operated or used by TID: - Real-time flows, water level, and storage available for six sites via TID’s WISKI web portal - Current report and link to current flows at the Tuolumne River below La Grange Dam available on TID website - Links to seven online telemetry gauges used by TID and reported by USGS NWIS are available through the TID website. - CASGEM groundwater monitoring implemented by TID. - Information about groundwater supply wells provided by TID staff through pump tests. - Upper Tuolumne River watershed collaborative project to implement Forecast Informed Reservoir Operations (FIRO), a reservoir-operations forecasting strategy that is communicated to the TID Board of Directors, and available to the public through the Board process. - Suitability of surface water, groundwater, and drain water quality for irrigation is tested by TID staff and available to growers upon request. - Surface water monitored at Main Canal Drop 1 (Turlock Lake supply) and all spill locations twice during each irrigation season. - Groundwater samples from drainage wells and rented wells monitored as needed, upon request, and during the formation of a pump Improvement District. - Subsurface drainage at 32 tile drain discharge sites historically evaluated on a quarterly basis - Canal flows monitored by multi-parameter water quality sondes at 18 canal and drain locations, recording EC and temperature and upload the data to TID’s SCADA system. Agricultural water management educational programs and materials: - TID regularly prepares and distributes “The Grower” irrigation newsletter to growers, staff, and the public (now quarterly)	- Continued offering on-farm irrigation and drainage system services upon request: - Engineering services for ID facilities, including on-farm distribution and irrigation facilities, subsurface drains, and deep wells. - Pump flow rate testing and irrigation system application rate testing - Continued offering irrigation scheduling and crop evapotranspiration information (links to CIMIS information, weather, and precipitation forecasts on TID website) - Contracted with Land IQ to receive monthly crop ET data. - Continued monitoring and offering surface water, groundwater, and drainage water quantity and quality data to growers: - Water use information online, upon request, and in annual water use report - Real-time flows, water level, and storage data available online - Pump tests conducted for groundwater supply wells. - Continued CASGEM groundwater monitoring and plans for SGMA groundwater monitoring. - Continued and formalized FIRO forecasting - Continued monitoring suitability of surface water, groundwater, and drain water quality for irrigation (monitoring less frequent in recent years because of other operational efforts underway in TID) - SGMA annual reports track groundwater storage. - Continued providing agricultural water management educational programs and materials to growers, staff, and the public: - Prepared and distributed “The Grower” irrigation newsletter - Maintained and updated the “Irrigation Information” and “Education” webpages with resources and educational materials. - Maintained and updated the “Irrigation” webpage with links to educational materials and water data. - Continued targeted social media messaging. - Continued supporting local educators by participating in school assemblies, demonstrations, and career days. - Continued providing remote data access to staff and growers from SlipMeters and FlumeMeters. - Began shifting away from annual grower meetings and moving toward direct mailings and expanded use of new virtual communications mediums (social media, etc.) to enhance grower engagement. - Initiated periodic podcasts describing TID operations.	- Continue offering existing on-farm irrigation and drainage system services upon request. - Continue offering existing irrigation scheduling and crop evapotranspiration information. - Continue monitoring and offering surface water, groundwater, and drainage water quantity and quality data to growers. - Continue SGMA-related public outreach and involvement. - Begin implementing the Turlock Subbasin Groundwater Sustainability Plan (GSP) - Continue and expand groundwater and surface water monitoring under SGMA. - Continue providing agricultural water management educational programs and materials to growers, staff, and the public. - Continue targeted social media messaging. - Provide on-farm technical support for checking: <i>On-farm irrigation system designs</i> <i>On-farm reservoir designs</i> <i>Grower training sessions</i> - Continue producing periodic podcasts.

Water Code Reference No.	EWMP	Implemented Activities (pre-2020 and ongoing)	Updates Since Last AWMP (2020-2025)	Planned Activities
		- TID’s “Irrigation Information” webpage provides a wealth of resources and educational materials in an accessible and user-friendly format. - Irrigation tips for water conservation - Information on Rubicon gates - CIMIS weather station data - Water measurement educational resources - Groundwater management educational resources - TID’s most recently adopted AWMP and supporting documents. - TID’s “Irrigation” webpage provides links to educational materials and data from Don Pedro Reservoir, La Grange Dam, Turlock Lake, and other locations in the TID distribution system. - TID supports local educators by participating in school assemblies and demonstrations as well as career days and has created an “Education” webpage that provides education guides and videos to the public. - TID has developed training videos for staff, irrigators, and growers that provide information on the operation of Rubicon sidegates. These videos are available in English and Spanish on the TID website. - TID provides remote data access to staff and growers, providing delivery flows data for sidegates with SlipMeters and permanent FlumeGates. - TID employs an assistant engineer with a background in agriculture who provides on-farm technical support. Services include support of micro/drip conversion and on-farm reservoir sizing. - TID conducted annual grower meetings. - TID conducts occasional seminars for growers on various water management topics		
10608.48.c(13)	Evaluate the policies of agencies that provide the supplier with water to identify potential changes that allow more flexible deliveries and storage.	- TID partners with cooperating entities at Don Pedro Reservoir. - TID implements ARSS, F-CO, FIRO, and watershed monitoring to better track and understand the amount of water in the upper watershed and inform reservoir operations. - TID coordinates with applicable regulatory agencies that have the potential to impact the District’s flexibility in delivery and storage. - TID is a member of the West Turlock Subbasin GSA and is active in SGMA implementation and GSP development.	- Continued partnership with cooperating agencies and applicable regulatory agencies that have the potential to impact the District’s flexibility in delivery and storage. - Implementation of ARSS, F-CO, FIRO, and watershed monitoring to better track and understand the amount of water in the upper watershed and optimize reservoir operations to balance flood storage and water supply storage. - Active participation in local groundwater entities and initiatives, including SGMA efforts.	- Continue partnership with cooperating agencies and applicable regulatory agencies. - Continue implementation of ARSS, F-CO, FIRO, and watershed monitoring. - Continue active involvement in SGMA implementation, GSP development, and GSP implementation in coordination with other agencies in the Turlock Subbasin.
10608.48.c(14)	Evaluate and improve the efficiencies of the supplier’s pumps.	- TID has historically tested District-owned and rented wells generally once per year when in use, or upon request. - TID has trained employees in pump efficiency testing. - TID has a pump capital improvement program to rehabilitate and replace pumps when necessary. - TID has provided remote operation capabilities for many drainage wells. WDOs are able to turn on and shut down pumps using portable tablets to reduce operational spillage, reduce pump wear and tear, prolong pump life, and improve pump efficiency.	- Continued pump testing program for District-owned and rented pumps, and offering pump testing services for private pumps upon request (limited testing over last 3-5 years as manpower has been redirected to delivery measurement accuracy field-testing efforts) - WDOs have continued remote operation of drainage wells to reduce pump wear and tear, prolong pump life, and improve pump efficiency	- Continue pump testing program and offering pump testing services. - Continue providing remote pump operation capabilities to WDOs.

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7.6 EVALUATION OF WATER USE EFFICIENCY IMPROVEMENTS

CWC §10608.48(d) requires that AWMPs include:

... a report on which efficient water management practices have been implemented and are planned to be implemented, an estimate of the water use efficiency improvements that have occurred since the last report, and an estimate of the water use efficiency improvements estimated to occur five and 10 years in the future.

A description of which EWMPs have been implemented has been provided in the sections above. This section provides an evaluation of EWMP implementation and an estimate of water use efficiency (WUE) improvements that have occurred in the past and are expected to occur in the future.

As described elsewhere in this document, TID has, over time, effectively implemented a variety of EWMPs designed to: develop and maintain reliable surface water and groundwater supplies, prevent or reduce system losses, promote the efficient use of water, seek alternative sources of supply, and maximize the flexibility with which the District can deliver and store water. The value of evaluating WUE improvements (and EWMP implementation in general), from TID's perspective, is to identify the benefits of EWMP implementation and to identify those additional actions that hold the potential to improve TID's ability to provide customers with a reliable water supply.

First and foremost among the issues that must be considered in any evaluation of the benefits of EWMP implementation and WUE improvements is how any proposed actions may impact the water balance, and overall water supply availability (Davenport and Hagan, 1982; Keller, et al., 1996; Burt, et al., 2008; Clemmens, et al., 2008; Canessa, et al., 2011). For example, flows to deep percolation and seepage that could be considered losses in some settings are critical to maintaining the long-term sustainability of the underlying groundwater basin. Reduced seepage or on-farm WUE improvements could be considered beneficial in some areas, but would adversely impact local groundwater recharge. Similarly, spillage and tailwater are also recoverable flows. These flows are already being recovered locally, or have the potential to be put to beneficial use downstream. The only distribution system or on-farm losses that are not recoverable within TID, the underlying groundwater basin, or the San Joaquin River Basin as a whole, are canal and reservoir water surface evaporation and evaporation from irrigation application. These components represent a small portion of TID's water supply, resulting in a high water management fraction ranging from 98 to 99 percent (**Table 5.6**). An implication of this is that very little water can be made available through water conservation in TID to increase the State's overall water supply.

An essential first step in evaluating EWMP implementation and WUE improvements is a comprehensive, quantitative, multi-year water balance (see **Section 5**). Quantitative understanding of the water balance flow paths enables identification of targeted flow paths for TID water management objectives and WUE improvements, along with improved understanding of the beneficial impacts and consequential effects of EWMP implementation at varying spatial and temporal scales. The water balance enables evaluation of potential changes in flow path quantities and timing for any given change in water management.

Even where comprehensive, multi-year water balances have been developed, evaluating water balance impacts and WUE improvements is not a trivial task. Issues of spatial and temporal scale and the relatively small changes in annual flow path volumes (relative to year to year variation in water diversions and use) that result from most water management improvements coupled with the inaccuracies inherent in even the best water measurement greatly complicate the evaluation of WUE improvements. Additionally, the implications of recoverable and nonrecoverable losses at varying scales complicate the evaluation of WUE improvements, and consequential, potentially unintended consequences must be considered (Burns et al. 2000, AWMC 2004).

Given the aforementioned complexities inherent in evaluating WUE improvements and the extremely limited potential for increase to the State’s overall water supply, TID has developed a qualitative assessment of past WUE improvements and those expected to occur five and ten years in the future. The qualitative magnitude is expressed as None, Limited, Modest, or Substantial in order of increasing relative magnitude for each EWMP. Past WUE improvements are estimated relative to no historical implementation and relative to the time of the last plan (adopted in March 2021). Future WUE improvements are estimated for five years in the future (2030) relative to 2025 and for ten years in the future (2035) relative to 2025. The result of this evaluation is provided in **Table 7.5**.

TID will continue to seek out and implement water management actions that meet its overall water management objectives and result in WUE improvements. TID staff regularly attend water management conferences and evaluate technological advances in the context of TID’s water management objectives and regional setting. The continuing review of water management within TID, coupled with exploration of innovative opportunities to improve water management will continue to result in future water management innovations and additional WUE improvements.

Table 7.5. Evaluation of Relative Magnitude of Past and Future WUE Improvements by EWMP.

Water Code Reference No.	EWMP	Implementation Status	Marginal WUE Improvements ^{1,2}			
			Past		Future	
			Relative to No Historical Implementation ³	Since Last AWMP ⁴	5 Years in Future ⁵	10 Years in Future ⁵
10608.48.b (1)	Measure the volume of water delivered to customers with sufficient accuracy	Being Implemented	No Direct WUE Improvements			
10608.48.b (2)	Adopt a pricing structure based at least in part on quantity delivered	Being Implemented	None	Limited	Limited	
10608.48.c (1)	Facilitate alternative land use for lands with exceptionally high water duties or whose irrigation contributes to significant problems, including drainage.	Not Technically Feasible	Not Applicable to TID			
10608.48.c (2)	Facilitate use of available recycled water that otherwise would not be used beneficially, meets all health and safety criteria, and does not harm crops or soils.	Being Implemented	Modest (approx. 6,200 AF total annually)	None	None to Limited, Depending on Future Opportunities (Timing and Availability)	
10608.48.c (3)	Facilitate financing of capital improvements for on-farm irrigation systems	Being Implemented	Substantial	Modest	None to Limited, Depending on Future Needs	
10608.48.c (4)	Implement an incentive pricing structure that promotes one or more of the following goals: (A) More efficient water use at farm level, (B) Conjunctive use of groundwater, (C) Appropriate increase of groundwater recharge, (D) Reduction in problem drainage, (E) Improved management of environmental resources, (F) Effective management of all water sources throughout the year by adjusting seasonal pricing structures based on current conditions.	Being Implemented	Substantial	None	Limited, Depending on Change In Pricing Structure	
10608.48.c (5)	Expand lined or piped portions of the distribution systems, and construct regulatory reservoirs to increase distribution system flexibility and capacity, decrease maintenance and reduce seepage	Being Implemented	Substantial (Limited Reduction in Irrecoverable Losses)	Modest	Modest	
10608.48.c (6)	Increase flexibility in water ordering by, and delivery to, water customers within operational limits	Being Implemented	Substantial	Modest	Limited	
10608.48.c (7)	Construct and operate supplier spill and tailwater recovery systems	Being Implemented	Substantial	Modest	Limited	
10608.48.c (8)	Increase planned conjunctive use of surface water and groundwater within the supplier service area	Being Implemented	Substantial	Limited	Modest to Substantial	
10608.48.c (9)	Automate canal control structures	Being Implemented	Substantial	Modest	Modest	
10608.48.c (10)	Facilitate or promote customer pump testing and evaluation	Being Implemented	Modest	None (Limited Energy Conservation)	None (Limited Energy Conservation)	
10608.48.c (11)	Designate a water conservation coordinator who will develop and implement the water management plan and prepare progress report.	Being Implemented	The activities of the Water Conservation Coordinator and other TID staff to achieve WUE improvements through implementation of the EWMPs are described individually by EWMP.			
10608.48.c (12)	Provide for the availability of water management services to water users.	Being Implemented	Substantial	Limited	None to Limited	
10608.48.c (13)	Evaluate the policies of agencies that provide the supplier with water to identify the potential for institutional changes to allow more flexible water deliveries and storage.	Being Implemented	Substantial	None	None	
10608.48.c (14)	Evaluate and improve the efficiencies of the supplier’s pumps.	Being Implemented	Substantial	None (Limited Energy Conservation)	None (Limited Energy Conservation)	

¹ As noted herein and throughout this analysis, reductions in losses that result in WUE improvements at the farm or district scale do not result in WUE improvements at the basin scale, except in the case of evaporation reduction. All losses to seepage, spillage, tailwater, and deep percolation are recoverable within TID or by downgradient water users within the basin.

² In most cases, quantitative estimates of improvements are not available. Rather, qualitative estimates are provided as follows, in increasing relative magnitude: None, Limited, Modest, and Substantial.

³ WUE Improvements occurring in recent years relative to if they were not being implemented.

⁴ WUE Improvements occurring in recent years relative to the level of implementation at time of last AWMP (2020).

⁵ WUE Improvements expected in 2030 (five years in the future) and 2035 (ten years in the future), relative to level of implementation in recent years.

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Appendix A
Public Outreach and Resolution Adopting Plan

Public outreach and Resolution adopting Plan will be added following Plan adoption.

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Appendix B
Turlock Irrigation District's Planning Documents

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District Plans and Reports

TID develops and refines its guiding documents to be utilized as a living roadmap, with the flexibility to pivot and/or take advantage of emerging data and tools to best serve its customers, employees and the environment.

Resources



Strategic Plan



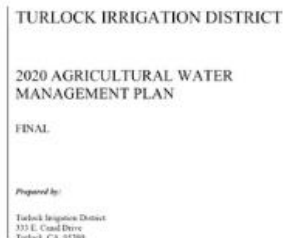
Sustainability Plan



Tuolumne River Management Plan



Integrated Resource Plan



Agricultural Water Management Plan



Groundwater Sustainability Plan



Wildfire Mitigation Plan



Local Hazard Mitigation Plan



Emergency Operations Plan

All plans can be viewed at <https://www.tid.org/news-resources/district-plans-and-reports/>

Appendix C
Example Newsletter

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TURLOCK IRRIGATION DISTRICT

THE GROWER



TID
WATER & POWER
Serving Central California since 1887



MARCH 2025

2025 Irrigation Rate Increase Approved

The TID Board of Directors approved the first rate increase for irrigation customers since 2015.

The approved 6% increase will be implemented over the next three years, beginning in 2025, with roughly a 2% increase each year.

Also approved was a change to the structure of TID's irrigation rates. Tiers 1-3 have been consolidated to a single rate to simplify the structure of how irrigation water is charged. The per acre-foot charges will increase to \$2.70 in 2025, \$3.23 in 2026, and \$3.83 in 2027 for Tiers 1-3, while Tier 4 will be a \$20 per acre-foot charge in all three years.

Also new, a \$200 Minimum Charge will be applied to all parcels. If a parcel uses less irrigation water than would amount to a \$200 charge, they will be charged the flat \$200 Minimum Charge.

The Fixed Charge in both Normal and Dry Year types will remain at \$60 and \$68 per acre, respectively.

Call Center Update

Effective with the start of the 2025 Irrigation Season, TID will be adjusting the hours of the Water Call Center to Monday through Friday, 7:00 a.m. to 5:00 p.m. The decision to close the Water Call Center on Saturdays, Sundays and holidays was made after observing a decline in calls on these days as a result of a steady increase in the number of Growers using the online system to order water.

In addition, there are more TID representatives available during the week to answer calls and the District believes that this will improve the customer service experience for those who still want to call in their water orders. Growers have the ability to order water through the online system 24 hours a day, seven days a week at waterrequest.tid.org.



February's Water & Power podcast featured Chief Hydrologist, Olivia Cramer.



Go to: TID.org/podcast or wherever you get your podcasts.

 /company/TURLOCKID



 @TURLOCKID

www.TID.org

2024-2025 Water Year Outlook

February storms have improved the outlook of the 2024-2025 Water Year, bringing the Tuolumne River Watershed closer to average conditions.

As of February 18, the watershed had received 18.76" of the 25.05" historic September through February precipitation—approximately 82.6% for this date. Snowpack as of the same date, is at 79.6% of average for the date and 61.5% of the April 1 average—the historic peak of snowpack in the watershed.

Don Pedro Reservoir elevation had increased slightly to 783.8', but is still well below the 801.9' flood control line.

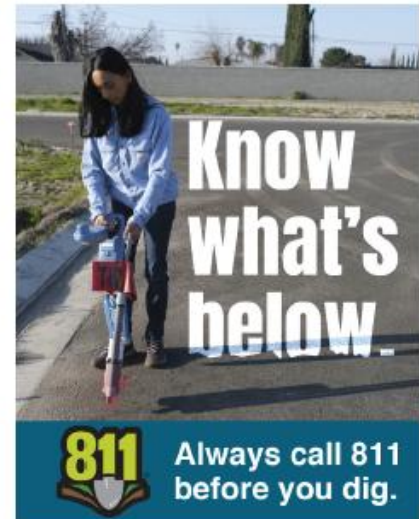
Despite the recent precipitation, there is still a wide spread of potential outcomes for the water year, depending on future weather events. If we experience wet conditions going forward, we could end around a 110% water year; with dry or average conditions going forward, we could end up between a 60%-75% water year.

Looking ahead, staff has recommended 42"-48" of available water for the 2025 Irrigation Season. The Board of Directors will consider setting the irrigation season and available water at the March 4, 2025 Board Meeting.



**INVESTING IN
Reliability**

To learn how TID is investing in reliability through the Don Pedro Life Extension Project, go to TID.org/Investingin.

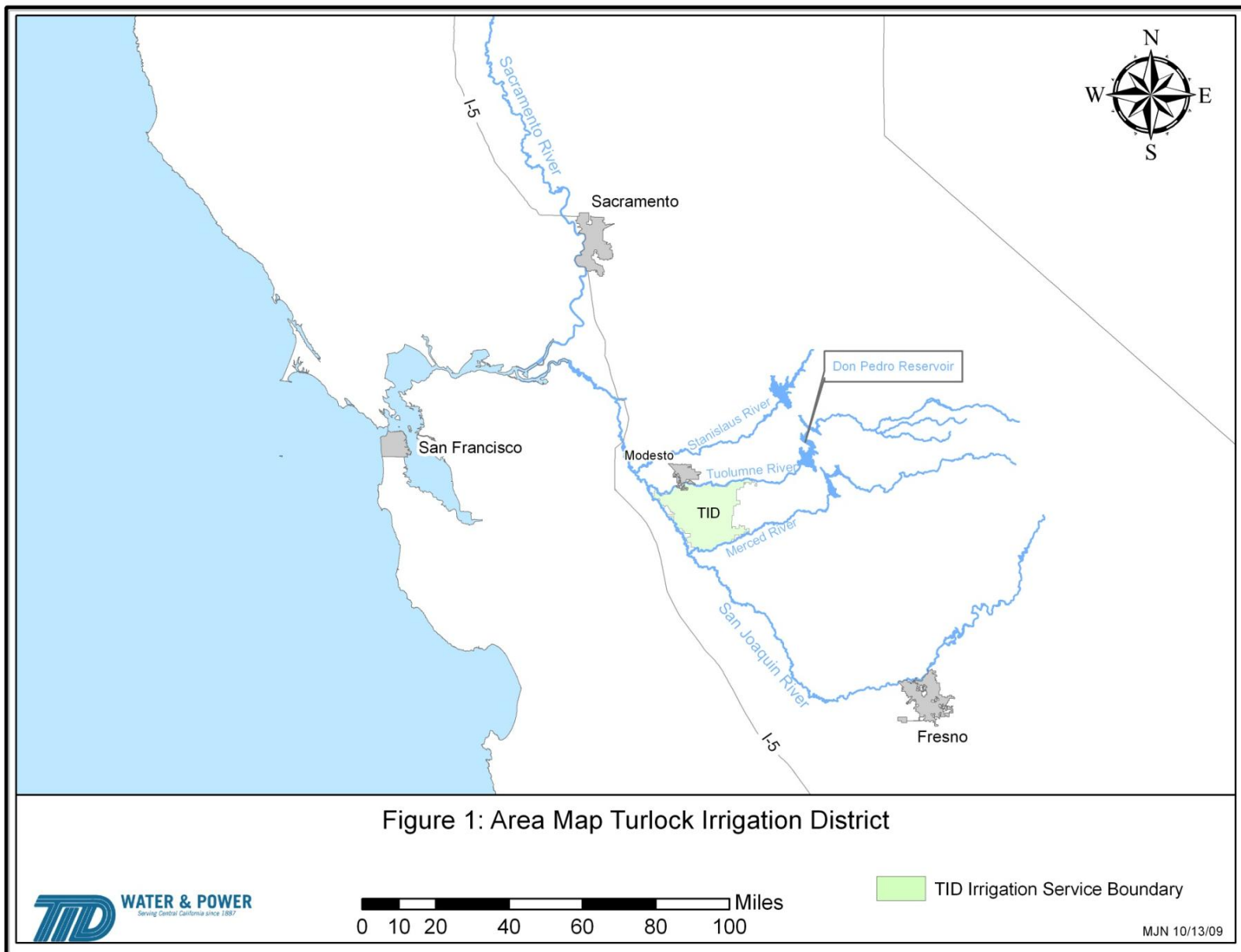


WATER CALL CENTER
Open 7 days a week during irrigation season from 7 a.m. to 5 p.m.
(209) 883-8456

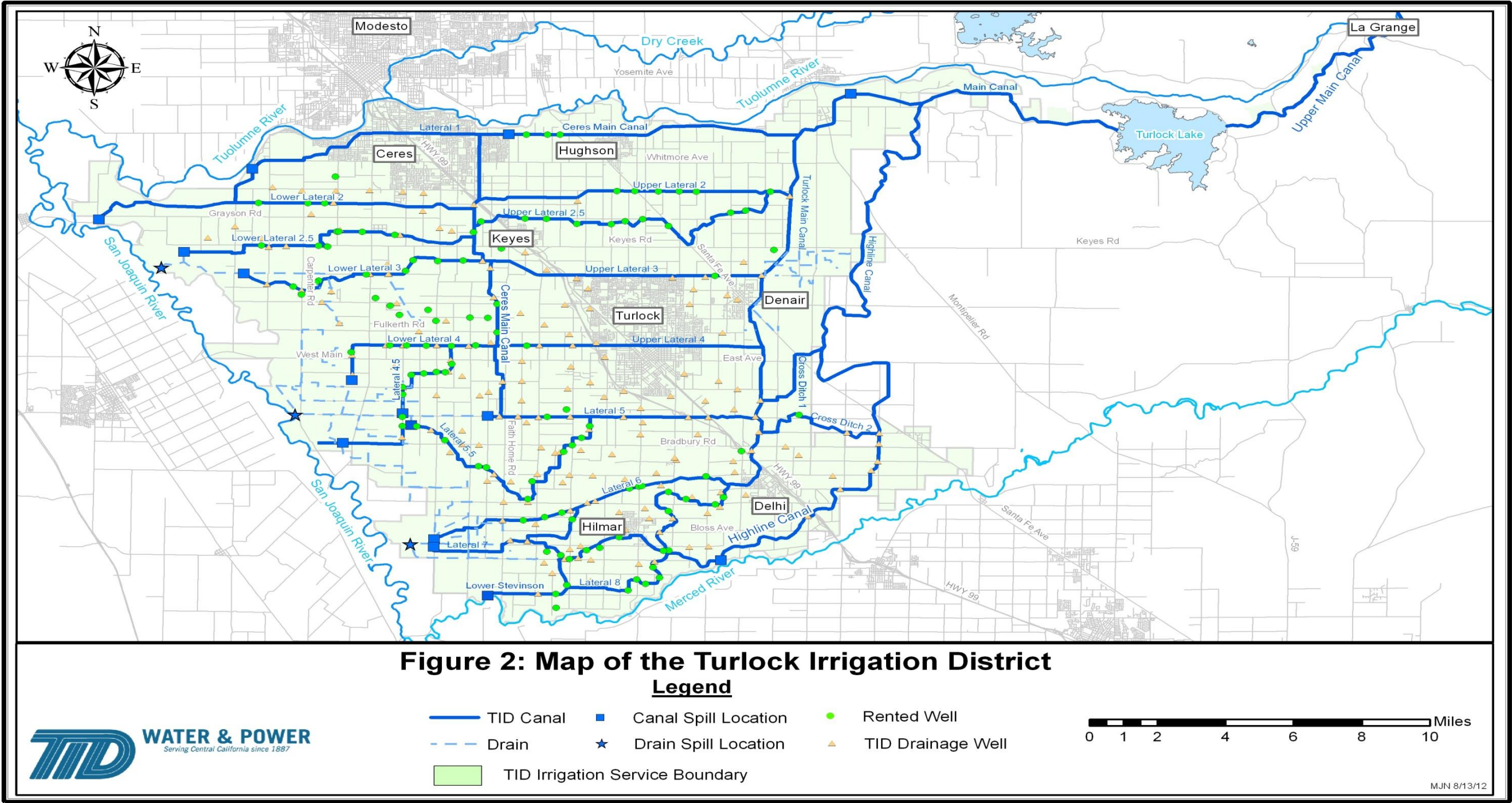
CONTACT US
Water Distribution
(209) 883.8356

Appendix D
District Maps

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Appendix E
Turlock Irrigation District Irrigation Rules

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The Turlock Irrigation District Irrigation Rules can be found online at:

<https://www.tid.org/wp-content/uploads/2025/03/Irrigation-Rules-Amended-Jan2025.pdf>

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Appendix F
Agricultural Water Measurement Regulation Documentation

TURLOCK IRRIGATION DISTRICT 2025 Agricultural Water Management Plan

AGRICULTURAL WATER MEASUREMENT REGULATION DOCUMENTATION

2025 AWMP Appendix F

Summary of Water Measurement Improvements (2021-2025)

As described in TID's 2020 AWMP Appendix F (Attachment F.1), TID has continued to make water delivery measurement improvements. Since 2020, TID has installed 37 new permanent water delivery measurement gates and continued to perform flow rate calibration at existing water delivery measurement gates. Table 1 summarizes TID's water measurement improvements by year. The flow rate calibration measurements completed include measurements used to develop calibration for new or previously inactive parcels and to refine and improve calibrations on existing water delivery measurement gates.

2025 Accuracy Evaluation for Existing Measurement Devices

As reported in the 2020 AWMP in Appendix F, section 6.3.2, the accuracy evaluation of the existing sidegates found that 73 out of 100 gates met the standard. Thus, the corrective actions were required for the existing sidegates. To improve the accuracy of the existing sidegates, TID planned to improve the calibration of the sidegates by continuing to perform spot flow calibration measurements and updating the calibrated flow rate with the additional flow measurement data. The plan was described in the 2020 AWMP in Appendix F, Attachment F.1. Table 2 summarizes the corrective actions and associated certification approaches and accuracy standards required for flood deliveries at TID sidegates.

The District began the validation corrective action plan in August of 2025. The random sampling procedure was implemented following the guidelines from 2019. Parcels were sorted using the random selection. Parcels were selected until the number required to pass (25 of each type (Fuji, Hach, and Rubicon FlumeMeter)) was reached.

The FlumeMeter irrigations were selected using the first verified single event of the 2025 irrigation season. The actual delivered volume (CFS*Duration) was compared to recorded volume from the Water Receipt stored in TXDB. Events were evaluated until 25 measurements passed. Thirty-two validation measurements were collected for FlumeMeter irrigations, and of these 32 measurements, 25 passed (78%).

The Fuji and Hach irrigations were selected using the random selection. As irrigations occurred a certified field employee collected the measurements. Measurements were gathered until 25 measurements passed. The recorded Fuji and Hach measurements were added to the previous SBX measurements to create a new average flow. The recorded measurement was then validated against this new average measurement. The average is used to compensate for varying flows occurring across different field checks. Sixty-one validation measurements were collected for Fuji and Hach irrigations, and of these 61 measurements, 53 passed (87%).

A summary of the flow rate calibration method and parcels with calibrated flow rates completed at existing sidegates in TID is provided in Table 3. The delivery measurement accuracy validation results are provided in Table 4.

Summary

The results of the 2025 field testing indicate that TID is measuring agricultural water deliveries in compliance with the Regulation.

Table 1. TID Water Measurement Improvements

Calendar Year	New Permanent Measurement Gates Installed	Flow Rate Calibration Measurements Completed ¹	Funds Expended
2020	0	2619	130,920
2021	0	2996	93,959
2022	0	2903	176,969
2023	37	2559	597,666
2024	0	2608	48,999
Totals	37	13,685	1,048,513

¹ Including rotating Flume and Slipgates and Hach current meters and Fuji pipe flow meters

Table 2. Summary of Corrective Actions and Associated Certification Approaches and Accuracy Standards for Flood Deliveries at TID Sidegates.

Corrective Action	Delivery Measurement Certification Approach	Accuracy Required (23 CCR §597.3(a))	Number of Sidegates	Assessed Area Served, acres	Assessed Area Served, Percent of Total District Area
New Device-- Continuous Flow Measurement Device*	Laboratory Certification of Flow Rate; Field Certification of Duration	+/- 10%	153	77,054	50%
Existing Device (sidegate)--Parcel Specific Average Flow Rate*	Field Certification	+/- 12%	1,175	77,619	50%
Total			1328	154,673	100%

*Some parcels measured by new devices also irrigate with drip/micro methods and are also included in the existing device sidegate and assessed area totals.

Table 3. Summary of Flow Rate Calibration Method and Parcels with Calibrated Flow Rates Completed at Existing Sidegates in TID.

Existing Sidegate Flow Rate Calibration Method	Number of Side- gates	Number of Parcels	Assessed Area Served, acres	Number of Parcels Calibrated	Assessed Area Served by Parcels Calibrated, acres	Assessed Area Served by Parcels Calibrated, % Total by Sidegate	Assessed Area Served by Parcels Calibrated, % Total District Area
Temporary Continuous Flow Measurement Device (Rubicon FlumeMeter)	507	1,210	33,389	1,210	33,389	100%	21%
Spot Electromagnetic Flow Meter (Hach FH950)	302	471	17,474	302	17,474	100%	13%
Flood Subtotals	809	1,681	50,863	1,681	50,863	100%	35%
Spot Ultrasonic Flow Meter (Fuji Portaflow)	366	668	24,323	668	24,323	100%	19%
Exempt--Non- Agriculture (Gardenheads)**	-	923	2,434	NA	NA	NA	NA
Total*	1,175	3,272	77,619	3,272	77,619	100%	53%

* Total number of sidegates and parcels exceeds those reported for existing devices (Table 3.1) because many parcels that pump also take a few flood deliveries and are thus included in both totals. Totals exclude exempt gardenhead parcels.

**Number of parcels and area based on TID delivery records in 2019, area is included in the area of the other existing sidegate flow rate calibration methods.

Table 4. Delivery Measurement Accuracy Validation Results by Device Type.

Device Type/ Calibration Method	Assessed Area Served		Approx. Assessed Area Served by Devices that Meet Accuracy Requirement of 23 CCR §597.3(a) per Field-Testing	
	Percent Total District Area	Acres	Percent Devices Meeting Accuracy Requirement*	Approx. Acres Served*
New Device— Continuous Flow Measurement Device**	47%	77,054	100%*	77,054* *
Existing Device (sidegate)-- Parcel Specific Average Flow Rate**	53%	77,619	84%	65,200
	Percent Total District Area	Acres**	Approx. Percent Area Served by Devices Meeting Accuracy Requirement*	Approx. Acres Served*
Total	100%	154,673	92%	142,254

*Per 23 CCR §597.4(b), if at least 75% of the field-testing random sample meets the accuracy requirements of 23 CCR §597.3(a) when combining the accuracies of delivery flow and delivery duration measurements, the entire area served by that device type is considered to meet the accuracy requirements.

**Some parcels measured by new devices also irrigate with drip/micro methods and are also included in the existing device sidegate and assessed area totals.

**Appendix F-1: Agricultural Water Measurement
Regulation Documentation**

For Turlock Irrigation District

By
Davids Engineering, Inc.

December 2020

APPENDIX F AGRICULTURAL WATER MEASUREMENT REGULATION DOCUMENTATION

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APPENDIX F AGRICULTURAL WATER MEASUREMENT REGULATION DOCUMENTATION

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Figure F5.7. Hach FH950 Magnetic Velocimeter with Measurement Access Vent Pipe in the Background.

Figure 5.8. Example Fuji Portaflow Calibration/Verification Measurement.

Figure 6.1. Comparison of Parcel Area Distribution between the Total Number of Parcels in TID (Blue Bars) and the Number of Parcels in the Samples Randomly Selected by PPS Methodology (Orange Bars).

Figure 6.2. Comparison of Parcel Area Distribution between the Total Area of Parcels with Flow Measurement by Existing Measurement Devices (Blue Bars) and the Area of Parcels in a 100-Parcel Sample Randomly Selected by PPS Methodology (Orange Bars).

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1.0 Introduction

The Turlock Irrigation District (TID or District) recognizes the need for accurate farm delivery measurements and uniform standards and procedures for measuring and recording farm water deliveries in order to: (1) provide cost-effective service to customers, and (2) generate improved operational records for planning and analysis. This appendix documents TID's compliance with the regulations requiring a specified level of delivery measurement accuracy that were incorporated into California Code of Regulations Title 23 Division 2 Chapter 5.1 Article 2 Section 597 (23 CCR §597) in July 2012.

1.1 BACKGROUND

Field investigations conducted by TID between 2002 and 2012 indicated that TID's measurement devices, referred to as sidegates, and associated measurement methods that were in place in 2012 were generally adequate for the aforementioned purposes, but that not all sidegates would satisfy the new accuracy standards required by 23 CCR §597. Thus, per regulation 23 CCR §597, TID developed a corrective action plan with a budget and schedule to achieve compliance by December 31, 2015. This plan for compliant agricultural water measurement and accuracy certification is described in **Appendix F** of TID's 2012 Agricultural Water Management Plan (AWMP) and was updated in **Appendix F** of TID's 2015 AWMP.

1.2 SUMMARY OF EFFORTS THROUGH 2020

Between 2013 and 2019, TID spent \$10.5 million to (1) install 151 new measurement devices to accurately measure deliveries to nearly 3,000 parcels covering about half of the District's assessed service area, and (2) develop calibrated flow rates for more than 3,000 existing sidegate-parcel combinations that cover the remaining assessed service area. These calibrated flow rates have been developed and certified to provide greater delivery accuracy through TID's Delivery Measurement Program.

In 2016, following review of flow measurement data collected between 2012 and 2015, TID determined that it was necessary to also calibrate flow rates based on the irrigation method and requested flow rate. These parameters were subsequently added to the sidegate-parcel calibration combinations, resulting in a unique calibrated flow rate for each *sidegate-parcel-irrigation method-requested flow rate* combination. These changes to the Delivery Measurement Program have improved the measurement accuracy for the wide range of delivery flows that TID provides to its customers and significantly increased the number of calibration flow measurements necessary. Between 2016 and 2019, TID spent between \$280,000 and \$1.5 million each year on delivery flow calibration efforts. Additionally, TID has modified its custom ordering and delivery measurement recording software to improve its functionality for recording accurate delivery measurement volumes.

District-wide, there are about nine hundred parcels served by multiple sidegates, so there are approximately 3,900 sidegate-parcel combinations, and many irrigation methods and requested flow rate combinations that must all be calibrated. **As of 2019, TID has completed initial calibrations per the corrective action plan for all active sidegates that don't fall under DWR exemptions.** In total, across all field testing methodologies, 100% of the assessed acreage served by the non-exempted active sidegates now receive calibrated delivery flow rates. TID

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plans to continue taking additional calibration measurements, as needed, to calibrate new flow requests from customers.

By the end of 2019, TID had verified through field-testing that the accuracy requirements were being met in accordance with 23 CCR §597³⁴ for deliveries made to approximately 86% of the assessed area within TID (Table F1.1). These include deliveries measured by:

- All new measurement devices (i.e., permanent Rubicon SlipMeters and FlumeMeters, serving 47% of the total assessed area in TID)
- Approximately 73% of existing measurement devices (i.e., sidegates), with calibrated flow rates developed and validated by field-testing (serving the remaining assessed area in TID)

At the end of 2019, TID had developed a plan for completing field-testing of existing measurement devices in 2020 to validate the accuracy of deliveries to the remaining assessed area in TID (**Attachment F.1**). Unfortunately, the public health guidelines resulting from the COVID-19 pandemic prevented additional field-testing in 2020. TID staff will work within the bounds of recommended public health guidelines to complete these measurements at the earliest opportunity available. The results of these measurements will be provided and discussed in the next AWPMP update.

Table F1.1. Delivery Measurement Accuracy Validation Results by Device Type.

Device Type/ Calibration Method	Assessed Area Served		Approx. Assessed Area Served by Devices that Meet Accuracy Requirement of 23 CCR §597.3(a) per Field-Testing	
	Percent Total District Area	Acres	Percent Devices Meeting Accuracy Requirement*	Approx. Acres Served*
New Device— Continuous Flow Measurement Device**	47%	72,977	100%*	72,977*
Existing Device (sidegate)--Parcel Specific Average Flow Rate**	53%	81,329	73%	59,370
	Percent Total District Area	Acres**	Approx. Percent Area Served by Devices Meeting Accuracy Requirement*	Approx. Acres Served*
Total	100%	154,306	86%	132,347

*Per 23 CCR §597.4(b), if at least 75% of the field-testing random sample meets the accuracy requirements of 23 CCR §597.3(a) when combining the accuracies of delivery flow and delivery duration measurements, the entire area served by that device type is considered to meet the accuracy requirements.

**Some parcels measured by new devices also irrigate with drip/micro methods and are also included in the existing device sidegate and assessed area totals.

³⁴ In accordance with 23 CCR § 597.4, TID conducted an initial certification of all devices, and conducted field-testing and field-inspection for random samples of measurement devices. Per 23 CCR § 597.4(b)(2), if at least 75% of the random sample met the accuracy requirements pursuant to §597.3(a), all devices of that given device type were considered to meet the accuracy requirements of 23 CCR §597.

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2.0 Compliance Requirements (23 CCR §597.1)

Briefly summarized, 23 CCR §597 requires agricultural water suppliers that provide water to 25,000 irrigated acres or more to measure the volume of water delivered to customers according to specific accuracy standards on or before July 31, 2012 (23 CCR §597.1(a)). The accuracy of existing measurement devices must be certified within ± 12 percent by volume (23 CCR §597.3(a)(1)). The accuracy of new or replacement measurement devices must be certified within ± 5 percent by volume in the laboratory if using a laboratory certification, or ± 10 percent by volume in the field if using a non-laboratory certification (23 CCR §597.3(a)(2)). The regulation further includes specific requirements for certifying and documenting the accuracy of existing and new measurement devices (23 CCR §597.4). Additionally, suppliers subject to the regulation are required to report certain information in their AWMP (23 CCR §597.4(e)).

TID serves more than 25,000 irrigated acres and is therefore subject to these regulations. TID has elected to use a non-laboratory (field-testing) certification approach for all new and existing measurement devices District-wide. Field-testing measurements were performed between August 2016 and October 2019 by staff trained in the use of state-of-the-art flow measurement devices, including the Rubicon SlipMeter, the Rubicon FlumeMeter, the Hach FH950 electromagnetic flow meter, and the Fuji Portaflow ultrasonic flow meter measurement devices. The Rubicon SlipMeter and FlumeMeter provide continuous flow rate measurements at the sidegate, while the Hach FH950 and Fuji Portaflow flow meters provide “spot” flow rate measurements at a point in time through an access vent downstream of a sidegate or booster pump downstream of a sidegate. For sidegates measured using meters that report flow rate, TID calculates the delivery volume as the measured delivery duration multiplied by the flow rate. TID’s accuracy certification procedure accounts for the accuracy of both these values when computing the overall measurement device accuracy. Best professional practices were used for all field-testing measurements. Initial certification of device accuracy was completed by field-testing a random and statistically representative sample of the existing measurement devices and new measurement devices after installation in the field.

Sections 4 through 6 of this appendix document the best professional practices and protocols used for field-testing, field-inspection, and analysis of all new and existing measurement devices. The procedures and associated results are also documented in a TID report approved by an engineer.

3.0 Completed Corrective Actions (23 CCR §597.4(e)(4))

To comply with 23 CCR §597, TID implemented the corrective action plan (or plan) described in **Appendix F** of TID’s 2012 AWMP and updated in **Appendix F** of TID’s 2015 AWMP. As described in the plan, TID installed new permanent measurement devices at 151 sites, including 142 sidegates, six sites downstream of sidegates³⁵, and three ID pipeline spillage sites. In 2019, 138 of the sidegates equipped with new measurement devices were actively used to irrigate nearly 73,000 assessed acres, nearly half of the District assessed service area. For the remaining

³⁵ Measurement devices downstream of sidegates are used primarily for ensuring that only one customer is irrigating, which allows TID to attribute the measurement at the sidegate to that customer. Due to the complexity of determining the travel time of delivery flows, these devices are not used directly in measurement calculations.

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active sidegates not replaced with new permanent measurement devices, TID has used portable measurement devices to develop calibrated flow rates that provide accurate deliveries for virtually all of the *sidegate-parcel-irrigation method-requested flow rate* combinations at existing sidegates. Calibrated flow rates for existing sidegates have been determined by TID staff and Water Distribution Operators (WDOs) trained to use the Rubicon FlumeMeter, the Hach FH950 electromagnetic flow meter, and the Fuji Portaflow ultrasonic flow meter measurement devices.

Currently, TID uses the following measurement devices throughout the District:

- Rubicon SlipMeters™
- Rubicon FlumeMeters™
- SonTek-IQ® Series Meters
- Hach FH950 electromagnetic flow meters
- Fuji Portaflow ultrasonic flow meters
- Permanent magnetic meters (mounted on booster pump systems)
- FlowLine™ down looker (in ID structures)

This section describes TID’s delivery facilities, the status of the corrective actions to date, a plan for recalibrating flows for parcels with changes to on-farm facilities, and a plan for integrating accurate delivery measurements into TID’s volumetric billing process.

3.1 TID DELIVERY FACILITIES OVERVIEW

3.1.1 Irrigation Deliveries

Sidegates³⁶ are the delivery points through which water is delivered from TID canals and laterals to customers. TID customers are the individual landowners (or land tenants) to whom TID delivers water. Customers are served either directly from the TID distribution system (**Figure F3.1**) or through facilities owned by groups of landowners organized under Improvement Districts (IDs). TID measures water deliveries at the sidegate, where responsibility for water control and management is passed from TID to its customers.

The predominant on-farm irrigation method in the TID service area is basin-check flood irrigation. The standard basin-check flood irrigation delivery rate (or “flood head”) is 15 cubic feet per second (cfs) or 20 cfs, depending on the on-farm or system capacity. Customers typically receive a full standard flood head, or more, unless the conveyance or on-farm system (open ditch or pipeline) lacks sufficient capacity. Growers are responsible for (1) controlling the destination of their delivery head while irrigating, and (2) passing the delivery head to the next grower, as instructed by the TID WDO. Customers on large pipelines with new measurement

³⁶“Sidegate” is the term that is used in TID for the “delivery point” defined in 23 CCR§597 as “...the location at which the agricultural water supplier transfers control of delivered water to a customer or group of customers....” (23 CCR §597.2(a)(6))

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devices are also able to order a specific requested flow rate as long as it is compatible with irrigation facilities and TID operations.

Water deliveries to parcels typically occur on a rotational schedule, with one parcel taking the full “head” of water delivered through the TID sidegate at a given time. The “head” of water is passed from parcel to parcel by growers, while the delivery duration varies according to parcel size and other factors. In a few cases, sidegates have the capacity for two heads and the heads are divided at a point below the sidegate. In these IDs, additional permanent FlumeMeters or SonTek-IQ meters have been installed at the point the heads are divided to identify which growers are taking water.

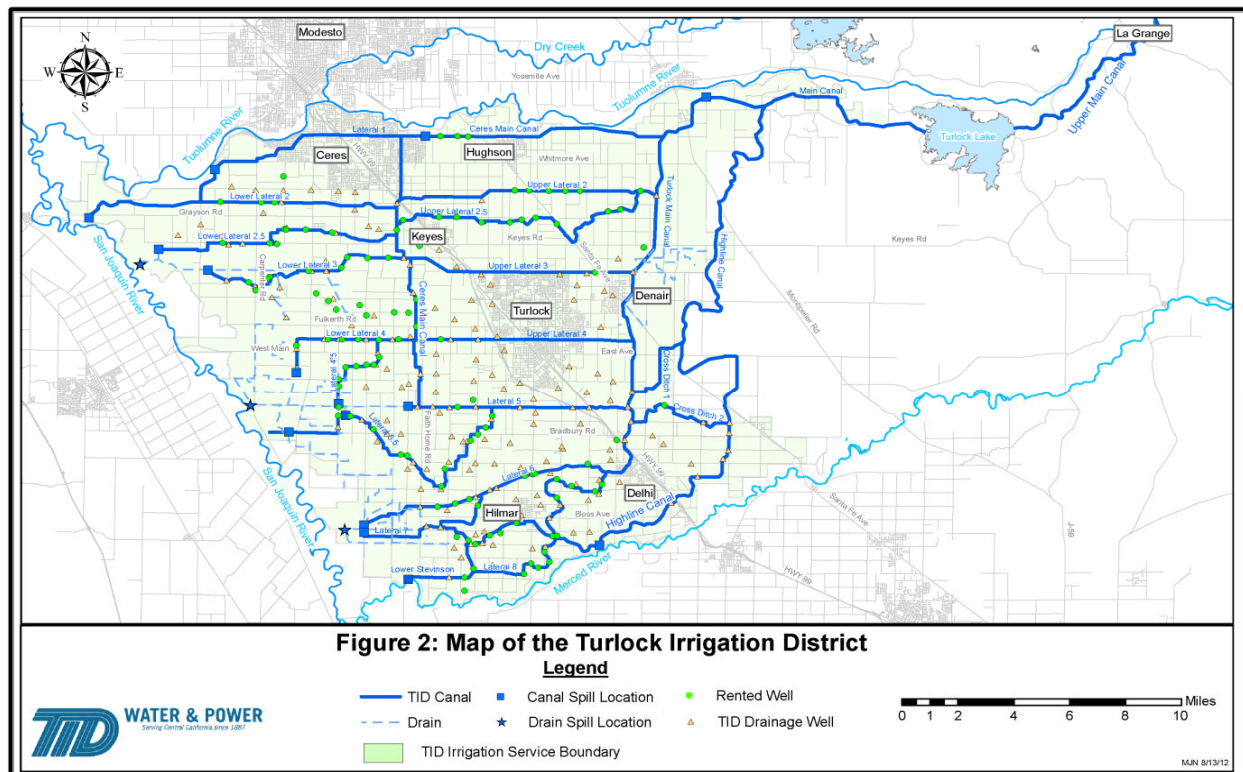


Figure F3.1. TID Distribution System.

3.1.2 Measurement Devices and Methodologies

As described previously, sidegates are the delivery points through which water is delivered from the TID system to customers. Sidegates are operated for measurement by consistently setting the sidegate opening to deliver a standard flood head, based on the sidegate size and the difference between the water levels upstream and downstream of the sidegate. Historically, sidegate-specific gate openings were developed so that the majority of parcels received at least a standard flood head (flow rate), as determined by flow measurements made by trained TID employees using portable electromagnetic flow meters. The sidegate openings are based on specific upstream water levels that are intended to, and generally do, remain steady during canal and lateral operations. The sidegate-specific openings were compiled and provided to WDOs tasked with delivering the water. In the future, TID also plans to provide this information to growers so

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they can verify that sidegates openings are correct, and that they are receiving a standard flood head.

Using TID's sidegates to measure delivery volumes at the parcel level (different from delivering a minimum flow rate) is complicated by two main factors:

- Downstream hydraulic conditions on sidegates can vary appreciably among parcels as the head is rotated and, relatively infrequently, even within individual parcels as irrigation "sets" are changed, resulting in flow rate fluctuations.
- Vent pipes are not always suitably located for observing downstream water levels and for conducting flow verification. In some cases, such as sidegates that discharge into pipelines, access to vent pipes is limited or impossible.

Two additional factors also present challenges to using TID's sidegates to measure delivery volumes at the parcel-level:

- Thirty-four sidegates supply ID pipelines that spill into other TID laterals, IDs, or drains.
- About 900 parcels can be supplied water by more than one sidegate.

TID's corrective action plan addressed the two main factors affecting delivery volume measurement at the parcel level for both flood heads and for drip and micro system booster pumps. TID installed new permanent measurement devices that are not affected by downstream conditions at 138 sidegates. These devices are installed at sidegates that together deliver water to nearly half of the assessed service area (**Table F3.1**). For the remaining active existing sidegates not replaced, TID developed specific calibrated average flow rates under standard hydraulic conditions (i.e. upstream water level in canal or lateral and sidegate opening) for each *sidegate-parcel-irrigation method-requested flow rate* combination in the District. This approach allows for accurate delivery measurement using existing measurement devices by accounting for varying downstream conditions at each parcel. TID has inventoried parcels that irrigate with booster pumps and has also developed calibrated flow rates for these parcels.

TID also delivers water to about 600 gardenhead parcels (hobby farms) that are each five acres or less, irrigate on a pre-set rotational group schedule and grow small pastures, lawns, ornamentals, or produce for self-consumption. These parcels are not subject to the regulation according to DWR's response to comments on the regulation³⁷.

3.2 INSTALLATION OF NEW PERMANENT MEASUREMENT DEVICES

TID currently has real time measurement data for nearly 73,000 assessed acres using permanent measurement devices installed at 142 sidegates. The majority of these new permanent measurement devices are Rubicon SlipMeters and Rubicon FlumeMeters. Both of these new gates use Rubicon's Sonaray measurement technology, and are laboratory certified to ± 2.5 percent flow rate accuracy (Judge, 2011). Field tests in California irrigation district conditions found that the Sonaray measurement was within ± 2.0 percent of an NIST certified magnetic flow

³⁷ Based on DWR's Final Statement of Reasons dated 5/31/12, response number G24.

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meter (Hopkins and Johansen, 2011). To improve the measurement accuracy of delivery volumes, TID trains WDOs and irrigators to use the gates, and has made training videos in English and Spanish that are available on the TID web site and YouTube.³⁸

In most installations, a SlipMeter completely replaces an existing sidegate and will automatically adjust its opening to accurately deliver a desired flow rate. The SlipMeter can also be set to maintain a specified gate opening. A few SlipMeters are mounted on frames in front of the existing sidegates. In these cases the sidegates are still manually adjusted to control the delivery flow rate, while the SlipMeter is primarily used as a measurement device. FlumeMeters are also installed in front of existing sidegates. A few FlumeMeters are installed in ID pipeline structure boxes where the ID pipeline branches, and are used to measure flow at the split. Both SlipMeters and FlumeMeters send digital data to TID in real time via TID's Supervisory Control and Data Acquisition (SCADA) system. TID has completed the installation of new permanent flow measurement devices. TID plans to continue to review delivery measurement accuracy and customer needs. TID has added additional permanent measurement devices based on this review, and may install more permanent flow measurement devices in the future.

Table F3.1. Summary of Corrective Actions and Associated Certification Approaches and Accuracy Standards for Flood Deliveries at TID Sidegates.

Corrective Action	Delivery Measurement Certification Approach	Accuracy Required (23 CCR §597.3(a))	Number of Sidegates	Assessed Area Served, acres	Assessed Area Served, Percent of Total District Area
New Device-- Continuous Flow Measurement Device*	Laboratory Certification of Flow Rate; Field Certification of Duration	+/- 10%	142	72,977	47%
Existing Device (sidegate)--Parcel Specific Average Flow Rate*	Field Certification	+/- 12%	1,195	81,329	53%
Total			1,333	154,306	100%

*Some parcels measured by new devices also irrigate with drip/micro methods and are also included in the existing device sidegate and assessed area totals.

3.3 FLOW RATE CALIBRATION FOR EXISTING SIDEGATES

At existing sidegates with access vents that are not suitably located for delivery flow measurement and calibration using handheld measurement devices, a Rubicon FlumeMeter was

³⁸ <https://www.tid.org/irrigation/irrigation-information/how-to-operate-rubicon-equipped-sidegates/>

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temporarily installed and used to develop calibrated delivery flow rates for each *sidegate-parcel-irrigation method-requested flow rate* combination. These calibrated flow rates are calculated based on the average flow rate observed from the FlumeMeter continuous flow measurements available from SCADA. Once at least one delivery event was measured for all active parcels served by a sidegate, the Rubicon FlumeMeter was moved to another sidegate. In total, TID has used 57 mobile FlumeMeters to develop calibrated delivery flow rates at 550 existing sidegates that serve 1,196 parcels, representing 32,187 assessed acres, or approximately 21 percent of the District (**Table F3.2**).

For sidegates with access vents in suitable locations for delivery flow measurement and calibration using handheld measurement devices, a handheld Hach FH950 electromagnetic flow meter was used to determine calibrated flow rates specific to each *sidegate-parcel-irrigation method-requested flow rate* combination. The Hach FH950 flow meter provides a “spot” flow rate measurement at a specific point in time using an access vent downstream of a sidegate. Hach FH950 meters were used at 349 sidegates serving 536 parcels that together represent 19,345 assessed acres, or approximately 13 percent of the District (**Table F3.2**).

For parcels with pressurized on-farm systems served by existing sidegates, a handheld Fuji Portaflow ultrasonic flow meter was used to determine calibrated flow rates specific to each *sidegate-parcel-irrigation method-requested flow rate* combination. The Fuji Portaflow meter also provides a “spot” flow rate measurement at a specific point in time. Fuji Portaflow meters were used at 471 sidegates serving 877 parcels that together represent 29,798 assessed acres, or approximately 19 percent of the District (**Table F3.2**).

See **Section 5.3** of this appendix for additional details on the flow rate calibration process for existing sidegates. Across all field testing methodologies, 100% of the assessed acreage served by existing active sidegates now receive calibrated delivery flow rates. The flow rate calibration for existing sidegates is virtually complete. However, when irrigation methods or requested flow rates change at each sidegate-parcel combination, the new *sidegate-parcel-irrigation method-requested flow rate* combination requires a new calibrated flow rate. Thus, there will likely always be some flow rate calibration being conducted.

Figure F3.2 shows the parcels in TID that have calibrated flow rates and indicates that about 15 parcels, less than one percent, still do not have calibrated flow rates for various reasons described below. Some parcels are only irrigated one to two times per year, providing insufficient opportunities for calibration. Two parcels do not have access vents installed, although one is coming out of production, according to the owner. Deliveries to one parcel were historically ordered on a different sidegate, so TID did not have accurate records to plan for vent installation. TID planned to install the vent in 2020, but was unable to do so because of the public health guidelines resulting from the COVID-19 pandemic. One parcel was measured for calibration, but TID later found that the measurement was incorrect. TID planned to measure deliveries to this parcel again in 2020, but was prevented from successfully completing this effort due to the public health guidelines resulting from COVID-19. Four parcels are irrigated using a shared system, so in the past TID has had problems isolating the parcels individually. TID also planned to identify irrigations to each parcel in 2020 by gathering additional information from the customer, though these efforts were again hindered by the public health guidelines due to COVID-19. Deliveries to the last parcel serve multiple ponds. Calibration measurements have presented difficulty because the pipe to the second pond is never full. TID is working to resolve

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this issue. TID plans to complete the efforts it was unable to accomplish in 2020 due to COVID-19 at the next available opportunity. Updates to these efforts will be discussed in the next AWMP update.

Table F3.2. Summary of Flow Rate Calibration Method and Parcels with Calibrated Flow Rates Completed at Existing Sidegates in TID.

Existing Sidegate Flow Rate Calibration Method	Number of Sidegates	Number of Parcels	Assessed Area Served, acres	Number of Parcels Calibrated	Assessed Area Served by Parcels Calibrated, acres	Assessed Area Served by Parcels Calibrated, % Total by Sidegate	Assessed Area Served by Parcels Calibrated, % Total District Area
Temporary Continuous Flow Measurement Device (Rubicon FlumeMeter)	550	1,196	32,187	1,196	32,187	100%	21%
Spot Electromagnetic Flow Meter (Hach FH950)	349	536	19,345	536	19,345	100%	13%
Flood Subtotals	899	1,732	51,531	1,732	51,531	100%	35%
Spot Ultrasonic Flow Meter (Fuji Portaflow)	471	877	29,798	877	29,798	100%	19%
Exempt--Non-Agriculture (Gardenheads)**	-	593	926	NA	NA	NA	NA
Total*	1,370	2,609	81,329	2,609	81,329	100%	53%

* Total number of sidegates and parcels exceeds those reported for existing devices (Table 3.1) because many parcels that pump also take a few flood deliveries and are thus included in both totals. Totals exclude exempt gardenhead parcels.

**Number of parcels and area based on TID delivery records in 2019, area is included in the area of the other existing sidegate flow rate calibration methods.

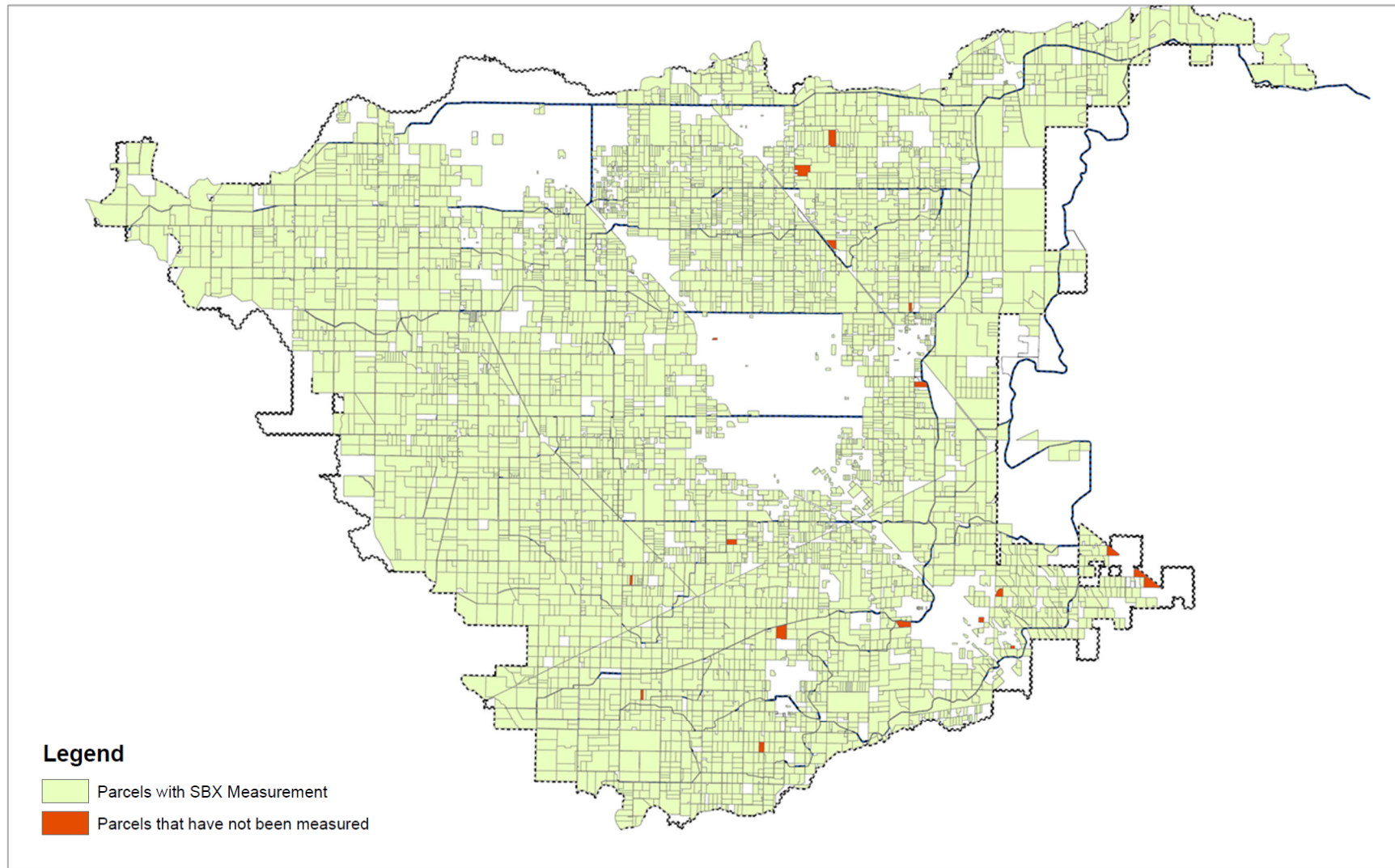


Figure F3.2. Map of Parcels with Completed Calibrated Delivery Flow Rate Measurements.

3.4 PLAN, SCHEDULE AND BUDGET FOR COMPLETION

In its plans for additional flow measurements, TID will prioritize the sidegates in the random samples found to have a flow rate accuracy that is outside of the acceptable range to meet SBx7-7 requirements. These measurements will be collected to improve the accuracy of the average flow rate used as the calibrated flow rate for the *sidegate-parcel-irrigation method-requested flow rate* combination. The annual projected budget for additional flow measurements, operations and maintenance (O&M) activities, and capital replacement after 2020 is \$200,000 per year.

Unfortunately, the public health guidelines resulting from the COVID-19 pandemic affected the planned schedule for completing these additional flow measurements. TID staff will work within the bounds of recommended public health guidelines to complete these measurements at the earliest opportunity available. The results of these measurements will be provided and discussed in the next AWMP update.

3.5 USE OF CALIBRATION FLOWS WITH DELIVERY RECORDS AND BILLING

To provide growers a consistent basis for planning irrigations during an irrigation season, TID provides growers access to their calibrated flow rates for each of their *sidegate-parcel-irrigation method-requested flow rate* combinations. Customers are able to access this information either by phone through the Water Call Center or online by accessing their online water accounts (**Figure F3.3**). These calibrated delivery flow rates are developed following the procedure described in **Section 6** of this appendix, and are based on all flow measurements completed prior to the beginning of the current irrigation season. The volume of water delivered during each irrigation event is calculated using these calibrated delivery flow rates and the recorded start and end times of the delivery event.

As calibrations continue into the future, growers will be able to access their new calibrated flow rates by phone or online, as described above. These new calibrated flow rates will account for updates to average delivery flow rates based on additional flow measurements conducted during the prior irrigation season.

TID has updated their water ordering, delivery, and billing software to use the calibrated flow rates for billing. For reporting delivery volumes to DWR and for use in the TID water balance, TID updates the calibrated delivery flow rates at the end of each irrigation season and uses these updated values to calculate the measured volume of water delivered in the completed irrigation season.

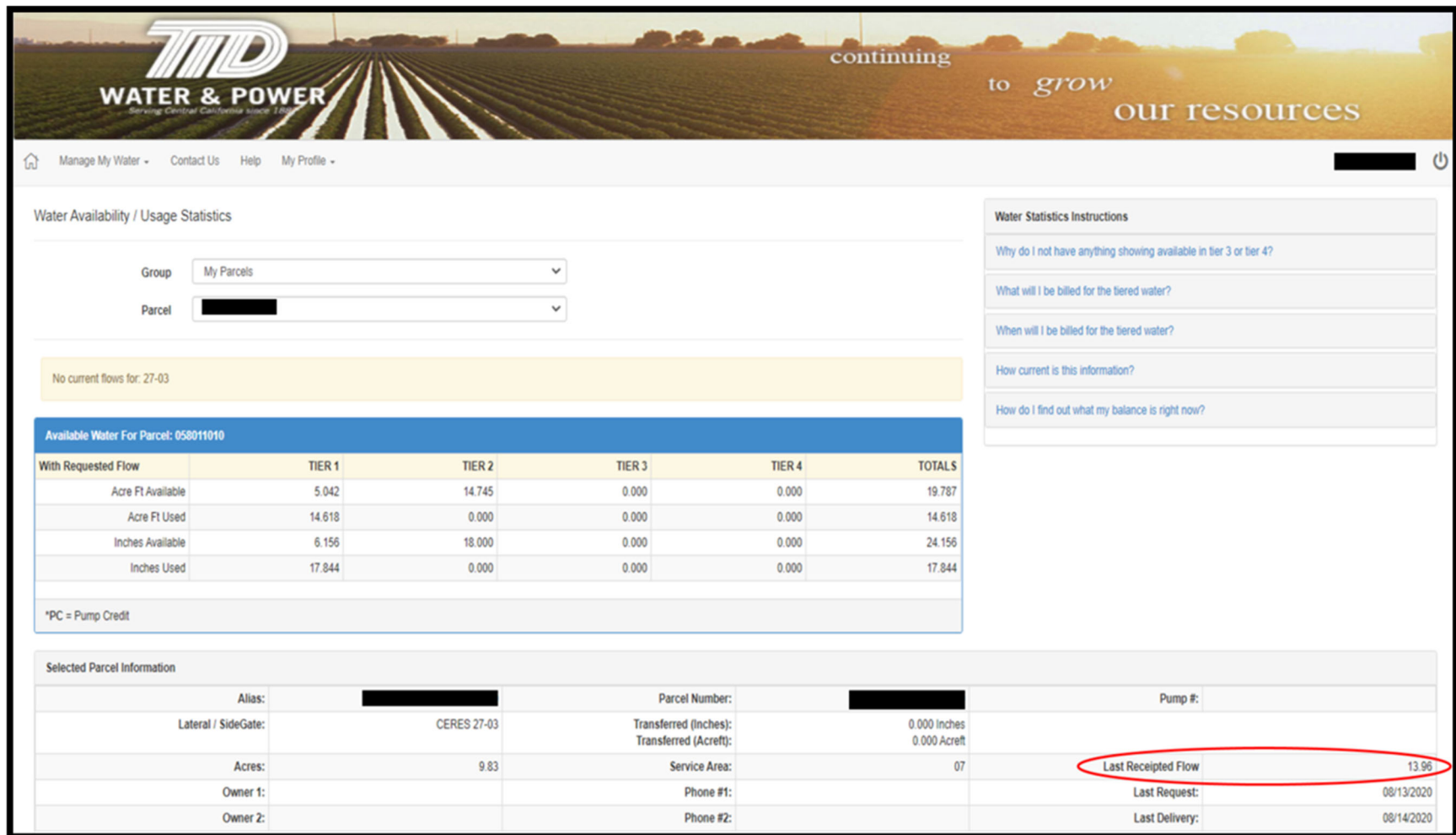


Figure F3.3. Online Water Account Screen Shot

3.6 PLAN FOR CALIBRATING FLOW RATES FOR NEW OR INACTIVE PARCELS

When TID receives a delivery request for a new *sidegate-parcel-irrigation method-requested flow rate* combination, TID will develop a calibrated delivery flow rate for this combination by measuring the flow rate during one of the first irrigation events. The new combination will be calibrated using the same methods used to calibrate flows at existing sidegates, typically using the mobile Hach FH950 meter, Rubicon FlumeMeter, or the Fuji Portaflow meter for parcels that use a pump. Each calibrated delivery flow rate is tracked by TID as a unique “Flow ID” corresponding to a single *sidegate-parcel-irrigation method-requested flow rate* combination. Until the actual calibration can be performed, TID will assign a parcel without a calibrated delivery flow rate an initial flow rate based on similar irrigation method – requested flow rate combinations.

4.0 Best Professional Practices (23 CCR §597.4(e)(2 and 3))

As described previously, sidegates are the delivery points through which water is delivered from the TID system to customers. Sidegates are operated for measurement by setting the sidegate opening to deliver a standard flood head (15 or 20 cfs) or another specific requested delivery flow rate, based on the sidegate size, the difference between the water levels upstream and downstream of the sidegate, and – since implementing the corrective action plan – conditions specific to each unique *sidegate-parcel-irrigation method-requested flow rate* combination.

Historically, sidegate-specific gate openings were set so that most parcels received at least a standard flood head, as determined by flow measurements made by trained TID employees using portable electromagnetic velocity meters. The sidegate-specific gate openings were based on specific upstream water levels that are intended to, and generally do, remain relatively steady during typical canal and lateral operations. The sidegate-specific openings were compiled and provided to WDOs tasked with delivering the water.

Currently, sidegate gate openings are precisely set to deliver the flow rate requested by the customer. For sidegates equipped with new measurement devices (Rubicon SlipMeters and FlumeMeters), the sidegate opening is guided by the Rubicon Sonaray measurement technology, providing the requested flow rate within ± 2.5 accuracy (Judge, 2011). For existing sidegates, the sidegate is opened to provide the calibrated delivery flow rate developed for each specific *sidegate-parcel-irrigation method-requested flow rate* combination (Sections 5 and 6 of this appendix).

TID has implemented a modified irrigation water ordering, delivery, and billing system. For sidegates with new, permanent water measurement devices, this system will determine delivery volumes based on the average measured flow rates of irrigation events from the previous season

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and delivery durations reported by WDOs.³⁹ For each distinct sidegate delivery event⁴⁰, the WDOs evaluate TID's SCADA records to identify and record the durations of delivery events. For existing sidegates, this system will determine delivery volumes based on the calibrated flow rates from the previous season specific to each *sidegate-parcel-irrigation method-requested flow rate* combination and the delivery durations recorded by WDOs.

4.1 COLLECTION OF DELIVERY MEASUREMENT DATA

TID collects water measurement data from 392 SCADA sites that collect upstream water levels, gate openings, and measured flows at regular intervals. These SCADA sites include all of the new permanent measurement devices installed at 138 active sidegates in 2019 as well as 17 additional locations and all of the 57 temporary, mobile FlumeMeter measurement devices. TID also collects water measurement data from TID-owned drainage wells, tile drain systems that discharge water into TID laterals, and spill sites at the end of TID laterals and canals. The SCADA data is regularly transferred into a SCADA Historian (PI) for storage, analysis and reporting of historic data.

TID also collects spot flow rate measurements with the Hach FH950 magnetic Velocimeter and Fuji Portaflow transit time flow meter. The detailed data collected by these devices are stored in Excel and text files. Average flows from each measurement are calculated and stored in TID's TXDB database.

4.2 FREQUENCY OF MEASUREMENTS

TID collects SCADA data at regular 5-minute intervals. Spot flow rate measurements are collected when growers ask for validation measurements of flows and at other times as needed. Start and end dates and times are collected and recorded by WDOs for each water delivery event.

4.3 METHOD FOR DETERMINING IRRIGATED ACRES

TID maintains a database of irrigated parcels that receive water deliveries. The assessed area of these parcels is included in the database and is adjusted downward six percent to estimate irrigated acres for the water balance, based on prior analysis of the average proportion of each parcel that is irrigated.

4.4 QUALITY CONTROL AND QUALITY ASSURANCE PROCEDURES

TID regularly reviews all water measurement data collected through TID's daily PI Data report and internal validation process. Growers are billed for the water volume delivered, and will

³⁹ If it is determined that the customer was overbilled, TID adjusts the flow rate to the current year average. TID also has six sites that are billed according to the actual volume of water recorded by the permanent measurement device.

⁴⁰ A "distinct sidegate delivery event" is defined as the duration between a start time (i.e. change from 0 cfs to desired delivery amount) and end time (i.e. change from desired delivery amount to 0 cfs) without any intermediate zero flows.

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likely contact TID if there is an error in the reported water volume delivered. If an error is found, TID staff promptly correct the error.

Additionally, water data collected by TID is used in a District-wide water balance. Prior to using this data in the water balance, the data is reviewed for out-of-range values and other possible errors. When assembled in the water balance, the data is again checked to ensure the highest possible data quality.

4.5 CONVERSION OF FLOW RATE TO VOLUME

Flow rates are converted to volume delivered by multiplying by the duration of the delivery. TID records delivery start and end dates and times in the ordering, delivery and billing software and calculates delivery duration from these values that are entered by WDOs based on information received from growers for parcels irrigated from existing gates. For new, permanent measurement devices, the WDOs obtain the start and end dates and times from SCADA and enter them into the ordering, delivery and billing system. TID has implemented a modified irrigation water ordering, delivery, and billing system that:

1. Uses SCADA reported measured flows and WDO recorded durations confirmed by SCADA delivery durations from the new, permanent measurement devices,
2. Uses calibrated flow rates specific to each *sidegate-parcel-irrigation method-requested flow rate* combination, and WDO recorded durations for existing sidegates,
3. Tracks water to the sidegate if it is delivered to parcels that can be served by multiple sidegates, and
4. Allows WDOs to adjust delivery volumes in the interest of fairness for the relatively rare situations when delivery service does not meet TID service standards.

5.0 Field Testing Methodology (23 CCR §597.4(b))

5.1 OVERVIEW

As described previously, TID installed new, permanent measurement devices at 142 sidegates, of which 138 were active in 2019. For the remaining existing sidegates, TID developed calibrated flow rates for each downstream parcel receiving deliveries that are specific to each *sidegate-parcel-irrigation method-requested flow rate* combination.

To certify the volumetric measurement accuracy of all measurement devices, the accuracy of the recorded delivery duration and the accuracy of the flow rate measurement must both be considered.

5.1.1 Accuracy Evaluation for New Measurement Devices

For new, permanent measurement devices, the *actual* duration is based on the start and end times of deliveries to individual downstream parcels that are recorded directly in TID's SCADA system. *Measured* duration is based on the start and end times of deliveries to individual downstream parcels that are calculated by TID's WDOs from review of the SCADA data, and that are then entered into TID's TXDB water order and delivery records database (TXDB). For these devices, the duration accuracy was determined through comparison between the *measured*

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durations calculated from WDO start and end times recorded in the TXDB and the *actual* durations calculated from SCADA field-reported start and end times to determine duration accuracy. The sample of *actual* durations calculated from SCADA field-reported start and end times was limited to single parcel delivery events so that there would be sufficient confidence that the SCADA start and end times were associated with the delivery event in question.

The new, permanent measurement devices have laboratory certified flow rate measurement accuracies of ± 2.5 percent.

5.1.2 Accuracy Evaluation for Existing Measurement Devices

For existing measurement devices, duration accuracy is based on an analysis of permanent devices in 2015 similar to the analysis described in **Section 5.1.1** of this appendix. During 2015, the method of determining beginning and ending times to enter into the TXDB was the same for new measurement devices with SCADA records as it was for existing devices without SCADA records.

Historically, *measured* duration was based on the start and end times of deliveries to individual downstream parcels that were reported by irrigators to TID's WDOs for entry into TID's TXDB database. The *actual* duration is defined based on the start and end times of deliveries to individual downstream parcels that are recorded directly in TID's SCADA system. During the 2015 analysis, the duration accuracy was similarly determined through comparison between *measured* durations and *actual* durations calculated from SCADA field-reported start and end times for single parcel delivery events. This analysis is described in the TID 2015 AWMP **Appendix F**, and resulted in an estimated duration accuracy of 7.6 percent.

For existing devices, flow rate measurement accuracy was field tested by making an additional measurement of the flow rate to a parcel after the calibration process for that parcel was complete. This additional *actual* flow measurement was compared to the calibrated (*measured*) average flow rate (comprised of the measured flows, not including the additional *actual* flow measurement) for the *randomly selected* parcels. Methodologies of random sample selection, new permanent measurement device duration accuracy field testing, and existing device flow rate accuracy field testing are described in the following sections.

5.2 RANDOM SAMPLE SELECTION

TID irrigated parcels range in size from less than five acres to 640 acres. Although the majority of parcels are less than 20 acres, the larger parcels account for the majority of the area (**Figures F5.1 and F5.2**). With this wide range in parcel areas, and the large number of small parcels, a simple random selection of measurement devices would over-emphasize the importance of deliveries to small parcels. Thus, the importance of each parcel was weighted according to its area using the probability-proportional-to-size (PPS) sampling method recommended by Burt and Geer (2012). Additionally, on any given day, only a subset of parcels were irrigating and thus available for a validation measurement, requiring the use of opportunity sampling also described in Burt and Geer (2012). On any given day, parcels were selected for validation measurements by sorting all parcels that have not already been field tested that are irrigating that day according to the random selection number assigned through the PPS sampling method.

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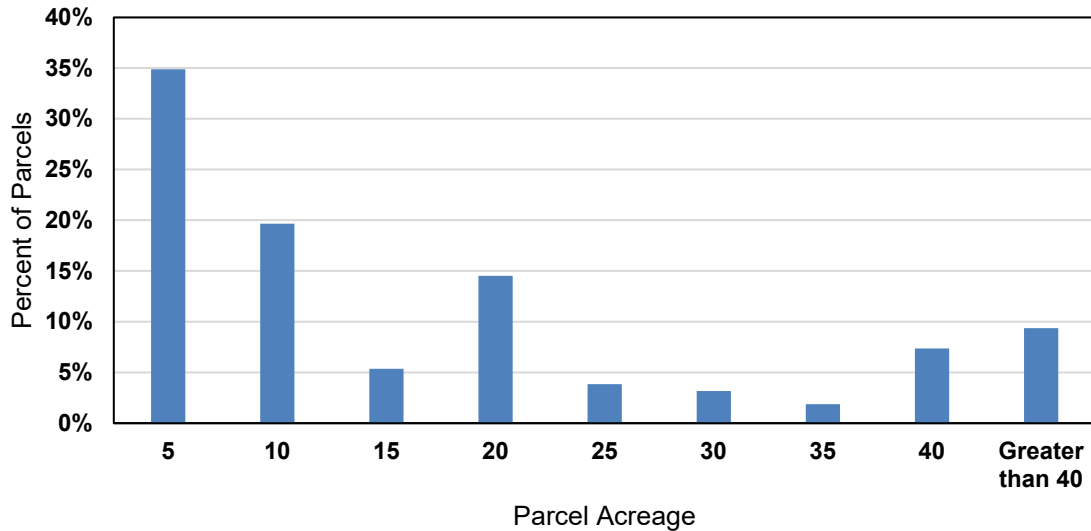


Figure F5.1. Parcel Distribution Based on Parcel Acreage and Percent of Parcels by Total Number of Parcels.

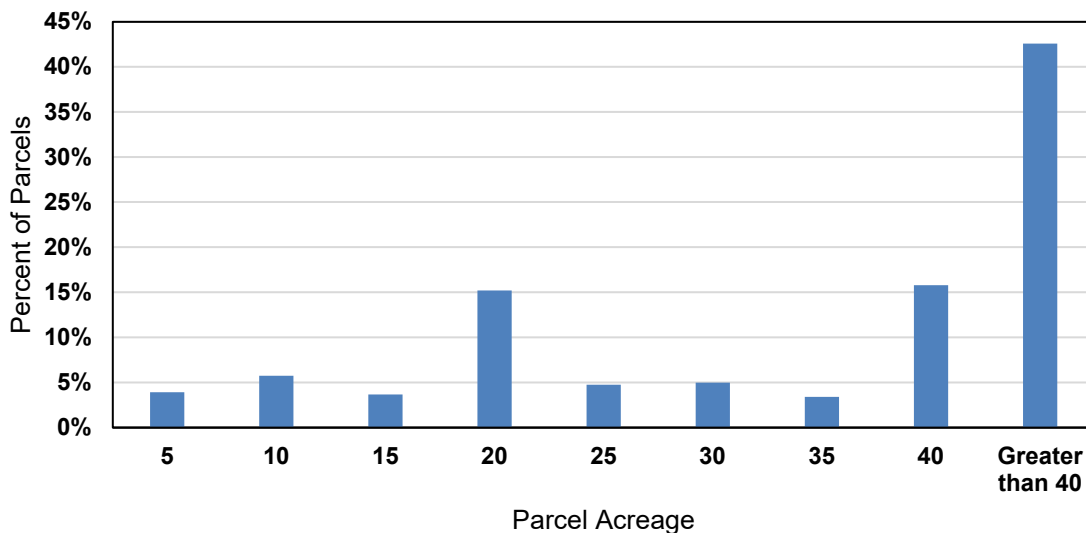


Figure F5.2. Parcel Distribution Based on Parcel Acreage and Percent of Total Area.

A parcel master list containing all parcels capable of receiving water from TID was provided to Davids Engineering. This list was divided into two lists, one for each device type: (1) new measurement devices, and (2) existing sidegates. For each device type, the PPS sampling methodology established a random selection number for each delivery event, or “Flow ID,” corresponding to a specific *sidegate-parcel-irrigation method-requested flow rate* combination.

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This number was used to develop a random sample of 100 delivery events for each device type according to the process below:

1. Flow IDs corresponding to each device type (new measurement device or existing measurement device) were divided into separate lists, and inactive Flow IDs were removed from each list.
2. Each Flow ID was listed in an arbitrary order and assigned a unique “acre range” equal to the irrigated acreages of that Flow ID. The acre range value was used to provide area-weighting for random selection. This assignment provides a probability of random selection of each Flow ID that is proportional to area.
 - a. All Flow IDs one acre or less are assigned one value (an “acre range” of one, e.g. an “acre range” range of 124-124).
 - b. All other Flow IDs were assigned an “acre range” beginning after the previous parcel’s upper range value plus the Flow ID parcel’s acreage (e.g., if a parcel has 20 acres and the previous parcel’s acre range spanned from 39-92 acres, the parcel’s acre range is 93-112).
 - c. A “total acre population” of 1-62,290 was developed (i.e., the first parcel’s acre range began at one acre, and the last parcel’s acre range ended at 62,290 acres).
3. Each acre in the total acre population was assigned a random number used to select a random sample. These acre values were then sorted by their assigned random numbers in ascending order.
4. Each Flow ID was identified for each acre randomly selected in step 3, resulting in a list of randomly selected Flow IDs. Flow IDs are included on the list one time for each acre (i.e., a Flow ID will be listed as many times as the number of acres it contains).
5. Duplicate Flow ID appearances were removed from the list of randomly selected Flow IDs list, retaining only the first occurrence of a Flow ID (ordered by the random number value, from lowest to highest).
6. A random validation selection number was assigned to each Flow ID in the list prepared in step 5, which was then sorted in ascending order to prepare a randomly ordered list of Flow IDs to evaluate.
7. A final, ordered validation list of Flow IDs was developed by matching the random validation selection number assigned in step 6 to its Flow ID in the original list. This list was finally sorted in ascending order by the validation selection number.

This procedure resulted in a randomly ordered list of all Flow IDs for each device type. The random sample of 100 Flow IDs was then identified by evaluating each Flow ID, in ascending order by validation selection number, and identifying whether key criteria were met (e.g. single delivery events; criteria described in the next section). The first 100 Flow IDs to meet these criteria comprised the random sample that was evaluated.

5.3 NEW PERMANENT MEASUREMENT DEVICES

5.3.1 Flow Rate Accuracy

The flow rate accuracy of the new permanent measurement devices (i.e. Rubicon FlumeMeters and SlipMeters) is laboratory certified to be 2.5 percent by the gate manufacturer (Judge, 2011). Field tests in California irrigation district conditions found that the Sonaray measurement was

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within ± 2.0 percent of an NIST certified magnetic flow meter (Hopkins and Johansen, 2011). **Figure F5.3** shows a typical SlipMeter installation at TID.

5.3.2 Duration Accuracy

The law of the propagation of uncertainty, and Burt and Geer (2012) describe a method to compute the resulting accuracy for volumetric measurement given known, or estimated accuracies of the various components of the volumetric calculation. Following this method, given the 2.5 percent accuracy of the flow rate, and the required 10 percent accuracy for field testing validation of new devices (23 CCR §597), the required accuracy of the duration measurement can be calculated as 9.7 percent (i.e. $(0.1^2 - 0.025^2)^{0.5} = 0.097$ or 9.7 percent).

Figure F5.4 shows an example of the single deliveries used in the field tests used to evaluate duration measurement accuracy. These events are defined as a delivery to a single parcel as indicated in the TXDB delivery record with no other deliveries at the sidegate within a 12 hour window preceding and following the recorded delivery. Events on parcels with the following characteristics were not included in the sample:

1. Parcels on sidegates which can spill to other IDs or TID laterals, and
2. Parcels known to receive water deliveries from more than one sidegate.



Figure F5.3. Rubicon SlipMeter used for New Permanent Flow Measurement Device; Installed on TID Upper Lateral 3 at Sidegate 2-9. Hach FH950 used to Develop Sidegate-parcel Specific Flow Rate Calibrations for Adjacent Sidegate 2-8.

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For the example in **Figure F5.4**, the duration analysis was conducted as follows:

1. The “actual” delivery duration was identified from SCADA records as the difference between the SCADA start time and SCADA end time (27 hours 26 minutes)
2. The “measured” delivery duration was identified from TXDB data as the difference between the TXDB start time and TXDB end time (27 hours 0 minutes)

The percent duration difference was calculated as the “measured” duration minus the “actual” duration, divided by the “actual” duration (-1.5%)

As described earlier the customer invoicing software changes include features to allow accurate tracking of duration on parcels known to receive water deliveries from more than one sidegate.

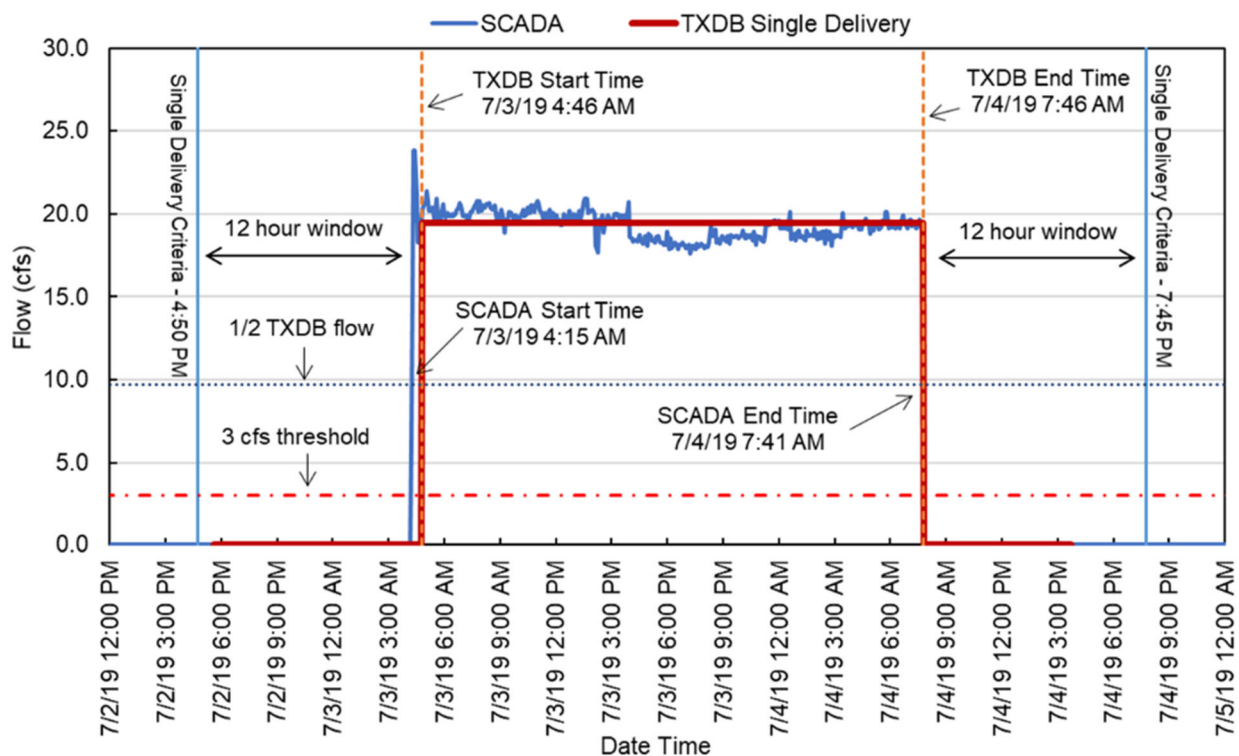


Figure F5.4. Example of Single Delivery used for New Measurement Site Duration Accuracy Analysis.

Additional quality control measures described below were applied to exclude delivery events with the following characteristics:

1. Delivery event less than or equal to 3 hours: durations are being reported by growers to WDOs and deliveries less than 3 hours require an absolute accuracy of around 9 to 10 minutes (10 percent of 180 is 18 minutes or 9 minutes on start time and 9 minutes on end time) given field conditions and manual start and stop of irrigations it is unreasonable to expect a better absolute accuracy than 10 minutes

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2. Delivery events with less than four SCADA records per hour—something was assumed wrong with the SCADA record.⁴¹
3. Manual review finds that this is not a single event
4. Manual review finds the delivery event is not to a single parcel
5. Adjusted durations where warranted in the following situations:
 - a. Spill sheet records spill water given to farmer—TXDB start and end times were adjusted to include the spill record
 - b. Well documented need to slowly fill pipe due to high O&M costs, SCADA duration was adjusted to not include fill time in duration

Failed events were graphically reviewed to verify the reason for failure. For each event excluded for one of the reasons listed above, the random delivery event with the next lowest random selection number was reviewed and either used or excluded depending on whether it met the quality control measures described above. This continued until the number of randomly selected parcels reached 100.

5.4 EXISTING SIDEGATES

5.4.1 Flow Rate Accuracy

Parcel specific flow rates for existing sidegates were developed in one of three ways. At existing sidegates without access vents in suitable locations for measurement, a Rubicon FlumeMeter was temporarily installed (see **Figure F5.5** for details), and the continuous record of flow rate was used to develop average flow rates for each parcel. Once at least one delivery event was measured for all the actively irrigating parcels served by a sidegate, the Rubicon FlumeMeter was moved to another sidegate.

⁴¹ SCADA measurements are collected at regular 5-minute intervals, so if less than four measurements are available per hour, this means that only 33.3% of SCADA measurements are in the record.



Figure F5.5. Rubicon FlumeMeter used for Sidegate-Parcel Flow Rate Calibrations; Temporarily Installed on TID Upper Lateral 4 at Existing Sidegate 2-4.

FlumeMeters were chosen to develop calibrated flow rates for 1,196 parcels representing 32,187 assessed acres, or approximately 21 percent of the District (**Table F3.1**). For existing sidegates with access vents in suitable locations for measurement, a Hach FH950 magnetic Velocimeter was chosen to determine calibrated flow rates. Hach FH950 meters were used for 536 parcels representing 19,345 assessed acres, or approximately 13 percent of the District. For parcels with pressurized on-farm systems served by existing sidegates, a Fuji Portaflow was chosen to determine calibrated flow rates. Fuji Portaflow meters were used for 877 parcels representing 29,798 assessed acres, or approximately 19 percent of the District.

Flow Ratings at Existing Sidegates Without Suitable Vent Access

At existing sidegates without access vents in suitable locations for measurement, the following steps were taken to develop calibrated flow rates, and to perform verification measurements:

1. Rubicon FlumeMeters measure flow rate with Rubicon's Sonaray measurement technology, and are laboratory certified to ± 2.5 percent flow rate accuracy.
2. FlumeMeter data was recorded in the TID SCADA system at regular five to 15 minute intervals.
3. WDO start and end times (determined from review of SCADA data) were used to determine individual delivery events.

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4. A time weighted average flow rate was developed for all delivery events by multiplying each flow rate by the duration and dividing by the total duration.
 - a. Generally, this average flow rate is nearly equivalent to simply averaging the flow rate values.
5. Flow values less than half of the ordered flow rate were assumed to be data transmission errors and were excluded from the average.
6. Sidegates with FlumeMeters were not visited during delivery events.
7. The average flows for delivery events with the same requested flow in the TXDB are averaged to become the calibrated average flow.
8. The average flow for the last event with the same ordered flow as the calibrated events (for parcels with more than one event) is not included in the average and used as the validation event.
9. The average flow rate for validation measurement is calculated using the same methodology as the average flow rate for the calibrated flows.
10. Similar to the new, permanent slip meters, parcels used in the validation analysis must be on side gates that:
 - a. Do not spill back to another ID or TID lateral, and
 - b. Do not take water from more than one sidegate.
 - c. Deliveries that lasted three hours or less are not included as validation events.

Flow Ratings at Existing Sidegates With Suitable Vent Access

For existing sidegates with access vents in suitable locations for measurement, the following steps were taken by trained WDOs to develop parcel specific flow rates, and to perform verification measurements:

1. WDOs collected comprehensive information about upstream and downstream conditions at the sidegate during the calibration/verification measurement.
2. A specialized rod, **Figure F5.6**, was used to determine pipe diameter.
3. The location and pipe diameter information was recorded on the field notes and entered into the Hach FH950.
4. Hach FH950 magnetic Velocimeters were used to measure average water velocity in the pipe.
5. Hach FH950 combines area and velocity data to provide a flow rate. The Hach data file was stored onto an SD card, and the flow rate was written on the field notes.
6. The SD card was returned to the office where the data was offloaded, quality controlled, and entered into TID's TXDB database.

Figure F5.6 shows the pipe diameter measurement device, and **Figure F5.7** shows the Hach FH950 magnetic Velocimeter.



Figure F5.6. Pipe Diameter Measurement Device.



Figure F5.7. Hach FH950 Magnetic Velocimeter with Measurement Access Vent Pipe in the Background.

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Flow Ratings at Existing Sidegates for Parcels with Pressurized On-farm Systems

For parcels with pressurized on-farm systems served by existing sidegates, the following steps were taken by trained WDOs to develop parcel specific flow rates, and to perform verification measurements:

1. The pipe diameter was measured with a special pipe diameter tape manufactured by Pipeman Products.
2. The pipe thickness was measured with Check Line Ultrasonic Wall Thickness Gauge Model #TI-25S pipe thickness transducer.
3. The pipe material, pipe diameter, and pipe thickness was recorded on the actual pipe at the rating point and entered into the Fuji Portaflow transit-time flow meter.
4. The Fuji Portaflow transducers were installed in a two pass “v” arrangement (**Figure F5.8**), and the flow rate data was recorded every 10 seconds for a period of 5 minutes onto an SD card, and the flow rate was written on the field notes.
5. The SD card was returned to the office where the data was offloaded, quality controlled, and entered into TID’s TXDB database.

Figure F5.8 shows a typical Fuji Portaflow calibration/verification measurement.



Figure F5.8. Example Fuji Portaflow Calibration/Verification Measurement.

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The velocity and transit-time flow meter measurements are spot measurements at one point in time with a single measurement representing the flow rate for the entire delivery. In all cases, the flow rate accuracy of the existing sidegates for a particular *sidegate-parcel-irrigation method-requested flow rate* combination is determined by comparing the average of all calibration measurements (i.e. measured flow rate) to a subsequent verification measurement (i.e. actual flow rate). Failed events were graphically reviewed to verify the reason for failure.

5.4.2 Duration Accuracy

For existing devices, the duration accuracy was assumed to be 7.6%, the same as determined by the analysis at the new, permanent measurement devices in 2015, as discussed in **Section 5.1.2** of this appendix.

6.0 Field Testing Results (23 CCR §597.4(b))

6.1 OVERVIEW

TID elected to use a field testing certification approach. Field-testing measurements performed between June 1 and September 4, 2019 by staff trained in the use of state-of-the-art flow measurement devices, including the Rubicon FlumeMeter, Hach FH950, and Fuji Portaflow measurement devices are included in this report. Best professional practices were used for all field-testing measurements.

6.2 SELECTION OF A REPRESENTATIVE RANDOM SAMPLE RESULTS

Figure F6.1 illustrates that the PPS methodology used selected predominately larger parcels as was intended. The blue bars represent the percent of the full population *by numbers of parcels* found within the various parcel acreage bins listed on the x-axis. The orange bars represent the percent of the 100 parcels randomly selected *by numbers of parcels* found within the various parcel acreage bins listed on the x-axis.

Figure F6.2 shows that the distribution of parcels by area in the sample more closely matches the distribution in the full population, the intended result of the PPS methodology. The blue bars represent the percent of the full population *by acreage* of parcels found within the various parcel acreage bins listed on the x-axis. The orange bars represent the percent of the 100 parcels randomly selected *by acreage* found within the various parcel acreage bins listed on the x-axis. It can be seen in this case, that the blue and orange bars are more or less evenly distributed among the various parcel acreage bins listed on the x-axis.

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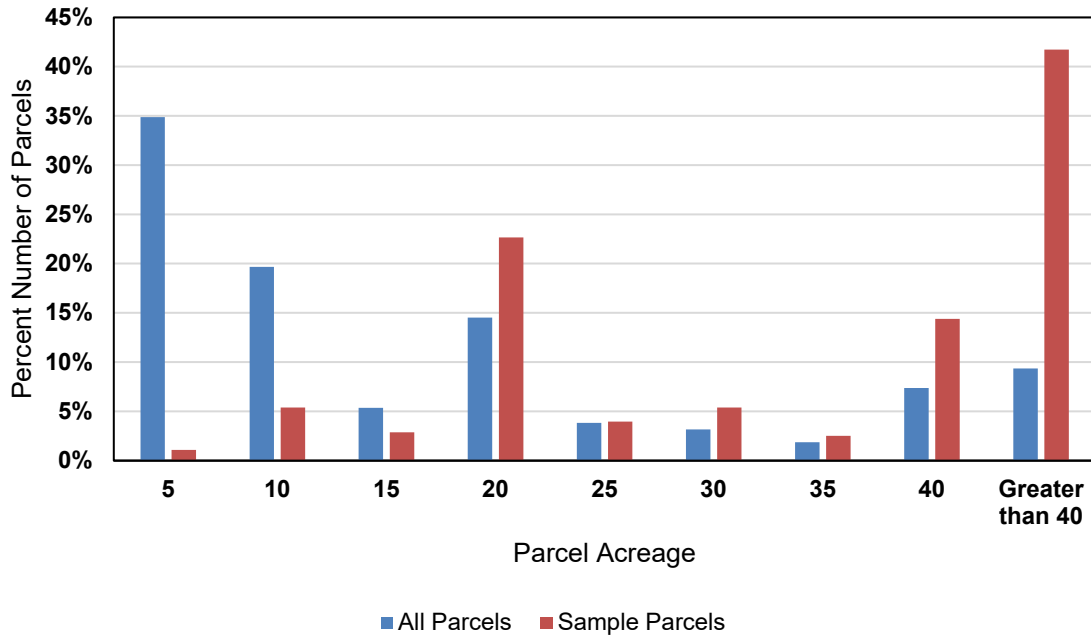


Figure F6.1. Comparison of Parcel Area Distribution between the Total Number of Parcels in TID (Blue Bars) and the Number of Parcels in the Samples Randomly Selected by PPS Methodology (Orange Bars).

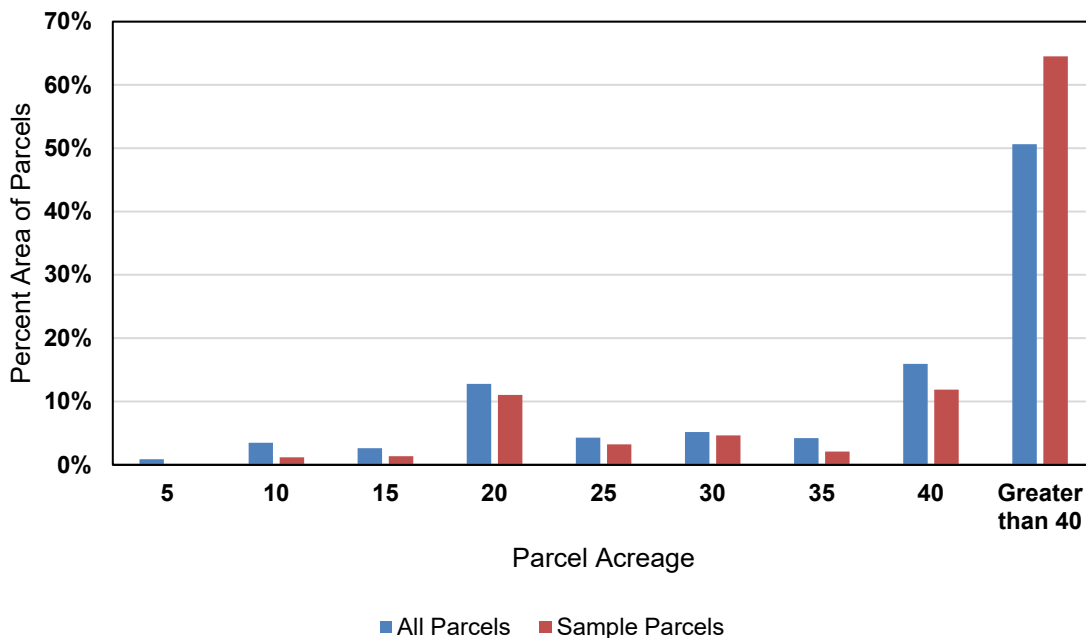


Figure F6.2. Comparison of Parcel Area Distribution between the Total Area of Parcels with Flow Measurement by Existing Measurement Devices (Blue Bars) and the Area of Parcels in a 100-Parcel Sample Randomly Selected by PPS Methodology (Orange Bars).

6.3 VOLUMETRIC ACCURACY CALCULATION RESULTS

6.3.1 New Permanent Measurement Devices

TID completed field tests on a random sample of 100 delivery events to 100 parcels to evaluate duration measurement accuracy. **Table 6.1** provides a summary of the duration field testing results. Since the new measurement devices have a laboratory-certified flow measurement accuracy of ± 2.5 percent, the duration measurement accuracy must be less than ± 9.7 percent to ensure the volumetric measurement accuracy was within the ± 10 percent required by 23 CCR §597 for field testing of new devices (i.e. $(0.1^2 - 0.025^2)^{0.5} = 0.097$ or 9.7 percent). The newly installed measurement gates meet the 23 CCR §597 accuracy standards, with 96 of the 100 verification measurements having duration accuracies less than or equal to ± 9.7 percent. Per 23 CCR §597.4(b), if at least 75% of the field-testing random sample meets the volumetric accuracy requirements of 23 CCR §597.3(a), the entire area served by that device type is considered to meet the accuracy requirements

As described in **Section 5** of this appendix, each of the selected 100 events was manually reviewed and 15 were eliminated because of spillage that occurred related to the event and seven were eliminated due to not being a single event. Each of the 22 events eliminated was replaced by the next random event so that the end total was 100 events. The average absolute value of the percent difference between the measured and the actual durations for the 96 parcels that passed the accuracy requirement was 1.6 percent. When combined with the flow rate measurement accuracy of 2.5 percent, this yields an average absolute volumetric measurement accuracy of 3.0 percent.

The average absolute percent difference between the measured and the actual durations for all 100 new permanent measurement devices tested was 3.5 percent. When combined with the laboratory-certified flow measurement accuracy of ± 2.5 percent, this yields an average absolute volumetric measurement accuracy of 4.3 percent – less than the ± 10 percent required by 23 CCR §597.

6.3.2 Existing Sidegates

TID also completed field tests on a random sample of delivery events to parcels served by existing sidegates with parcel-specific calibrated flow ratings using one of the three calibration methods described above. **Table F6.2** provides a summary of the flow rate field testing results. The same methodology used for measuring the delivery duration at the new measurement devices (described above) was also used for measuring the delivery duration at existing measurement devices. For this reason, the duration accuracy for existing devices was assumed to be 7.6%, the same as determined by the delivery duration analysis for new, permanent measurement device in 2015, as discussed in **Section 5.1.2** of this appendix. This duration accuracy was also used to calculate the required flow rate accuracy for the existing measurement devices. To ensure the volumetric measurement accuracy of existing devices was within the ± 12 percent required by 23 CCR §597 for field testing, the resulting flow rate measurement accuracy needed to be less than ± 9.3 percent (i.e. $(0.12^2 - 0.076^2)^{0.5} = 0.093$ or 9.3 percent). The majority of existing measurement devices (i.e. sidegates) meet the standard, with 73 percent having flow accuracies less than or equal to ± 9.3 percent. The average absolute percent difference between the measured and the actual flow rate for the parcels that pass the accuracy requirement was 3.0

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percent. When combined with the duration measurement accuracy of 7.6 percent, this yields an average absolute volumetric measurement accuracy of 8.2 percent.

The average absolute percent difference between the measured and the actual flow rate for all existing measurement devices tested was 8.4 percent, which when combined with the duration measurement accuracy of 7.6 percent yields an average absolute volumetric measurement accuracy of 11.3 percent. It is important to note that even though approximately 27% of the field tests did not pass the accuracy requirements, the average absolute value volumetric measurement accuracy across all tests is less than the ± 12 percent required by 23 CCR §597.

6.3.3 All Measurement Devices

The average absolute volumetric accuracy across all field-tested was found to be approximately 8.6 percent. This includes the average absolute accuracy of all field-tested new measurement devices – 4.3 percent – and the average absolute accuracy of all field-tested existing measurement devices – 11.3 percent.

7.0 Corrective Actions (23 CCR §597.4(d)(2))

As of 2019, TID has finished initial calibrations per the corrective action plan for active sidegates that don't fall under DWR exemptions. In total, across all field testing methodologies, 100% of the assessed acreage served by the non-exempted active sidegates now receive calibrated delivery flow rates. TID plans to continue taking additional calibration measurements, as needed, to serve new flow requests from customers.

By the end of 2019, TID had verified through field-testing that the accuracy requirements were being met in accordance with 23 CCR §597 for deliveries to 85% of the assessed area within TID. The remaining corrective actions that TID plans to complete are described below by device type.

7.1 NEW PERMANENT MEASUREMENT DEVICES

All of the sampled events passed the accuracy criteria, so no corrective actions are necessary.

7.2 EXISTING SIDEGATES

TID plans to correct the *sidegate-parcel-irrigation method-requested flow rate* combination calibrated flow rates that were outside of the required 9.3 percent accuracy by collecting additional spot flow measurements for those *sidegate-parcel-irrigation method-requested flow rate* combinations. The calibrated flow rate will then be updated to include the additional flow measurement data.

Table F6.1. Field Testing Results for New Measurement Devices.

Device Type	Total Assessed Area Served, acres	Duration		Flow Rate	Volume
		Percent Passing Field Tests*	Avg. Abs. Value Percent Diff. of Passing Field Tests	Avg. Abs. Value % Diff.	Avg. Abs. Value Volumetric % Diff
New Device--Continuous Flow Measurement Device	72,977	96%*	1.6%	2.5%	3.0%

*Per 23 CCR §597.4(b), if at least 75% of the field-testing random sample meets the accuracy requirements of 23 CCR §597.3(a) when combining the accuracies of delivery flow and delivery duration measurements, the entire area served by that device type is considered to meet the accuracy requirements.

Table F6.2. Field Testing Results for Existing Measurement Devices.

Device Type	Total Assessed Area Served, acres	Duration	Flow Rate		Volume
		Avg. Abs. Value % Diff.	Percent Passing Field Tests*	Avg. Abs. Value Percent Diff. of Passing Field Tests**	Avg. Abs. Value Volumetric % Diff
Existing Device (Sidegate)--Parcel Specific Average Flow Rate	81,329	7.6%	73%	3.0%	8.2%

*Per 23 CCR §597.4(b), if at least 75% of the field-testing random sample meets the accuracy requirements of 23 CCR §597.3(a) when combining the accuracies of delivery flow and delivery duration measurements, the entire area served by that device type is considered to meet the accuracy requirements.

**For existing devices, the weighted average is calculated across field tests conducted with the three different calibration methods described.

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At the end of 2019, TID had developed a plan for completing field-testing of existing measurement devices in 2020 to validate the accuracy of deliveries to the remaining assessed area in TID (Attachment F.1). Unfortunately, the public health guidelines resulting from the COVID-19 pandemic prevented additional field-testing in 2020. TID staff will work within the bounds of recommended public health guidelines to complete these measurements at the earliest opportunity available. The results of these measurements will be provided and discussed in the next AWMP update.

8.0 References

- Burt, C. and E. Geer. 2012. SBx7 Flow Rate Measurement Compliance for Agricultural Irrigation Districts. ITRC. California Polytechnic State University, San Luis Obispo, California.
- Hopkins, J.D. and K.R. Johansen. 2011. In-Situ Testing of a 600 mm Rubicon SlipMeter™ in Oakdale Irrigation District, CA. Provost & Pritchard Consulting Group. Clovis CA.
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Attachment F.1. TID Delivery Accuracy Certification Program Field-Testing and Certification Plan.

The following field-testing plan was prepared by TID staff in 2019 in anticipation of completing the accuracy certification of measurement devices during the 2020 season. Unfortunately, public health guidelines resulting from the COVID-19 pandemic prevented additional field-testing in 2020. TID staff will work within the bounds of recommended public health guidelines to complete these measurements according to the plan described below at the earliest opportunity available. The results of these measurements will be provided and discussed in the next AWMP update.

FIELD-TESTING OF EXISTING MEASUREMENT DEVICES IN 2020

- Early March: Confirm the field-testing plan.
- Early July: Develop random sample of FlowIDs (i.e., *sidegate-parcel-irrigation method-requested flow rate* combinations) for field-testing.
- Early August through Late September: TID will conduct field-testing of the FlowIDs in the random sample. Once complete, TID will provide field-testing results for analysis.
- November 15: Prepare draft report for review.
- Late November through Early December: Review and revise draft report.
- December 31: Complete final report.

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Appendix G
Turlock Irrigation District Drought Management Plan

Introduction

Since its formation in 1887, TID has faced variability in surface water supplies due to drought, leading to the development of TID's current water shortage allocation policies. These policies have been developed in response to the 1976-1977 drought, the most severe two-year drought in TID, and to the 1987-1992 and 2012-2016 and 2020-2022 droughts, the most severe and longest droughts in California's recorded history. Given the recent impacts and severity of the 2012-2016 drought, this drought is considered to be the archetypal drought for planning purposes in TID. A key aspect of TID's drought management policy is to plan for carryover storage in Don Pedro Reservoir and to plan for strategic, conjunctive management of surface water and groundwater supplies for a period of forecasted consecutive dry years. Prudent water supply planning requires TID to consider that the first dry year encountered may be the first year in a series of dry years, similar to the 1976-1977, 1987-1992, or 2012-2016 periods.

On April 1, 2015 Governor Brown issued Executive Order B-29-15, mandating agricultural water suppliers to include a detailed Drought Management Plan (DMP) describing actions and measures taken to manage water demand during drought in their 2015 Agricultural Water Management Plan (AWMP) update. In response to the Governor's Executive Order, TID developed a detailed description of existing policies and extraordinary actions undertaken in response to drought conditions. Three years later, Assembly Bill 1668 (AB 1668) was passed on May 31, 2018. AB 1668 amended the California Water Code (CWC) and requirements for AWMPs, providing more detail on the specific requirements of a Drought Plan, or DMP (CWC 10826.2). This DMP builds upon TID's long-standing shortage allocation policies and describes drought resiliency planning actions undertaken to prepare for drought, along with a broad range of actions undertaken during drought to manage available water supplies and to meet customer demands to the maximum extent possible.

The 2025 DMP includes all components that are required by CWC 10826.2 and that are recommended by DWR in its 2025 AWMP Guidebook (DWR 2025). Additionally, as described in the 2025 Guidebook, the 2025 DMP uses lessons from the 2012-2016 drought to inform the assessment of drought conditions and for planning purposes.

The DMP describes TID's drought resilience and drought response planning efforts, organized under the following categories:

- Drought resilience planning
 - Determination of water supply availability and drought severity
 - Potential vulnerability to drought
 - Drought resilience opportunities and constraints, specifically:
 - Availability of new technology or information
 - Availability of additional water supplies
 - Other planned actions
- Drought response planning
 - Policies and processes for water shortage declaration and water shortage allocation and implementation
 - Operational modifications to increase efficiency

- Methods and procedures for triggering and enforcing water shortage response actions
- Monitoring and evaluation of the Drought Management Plan
- Communication protocols and procedures
- Evaluation of the 2012-2016 drought, and its impacts on water supply and demand in TID

Drought Resilience Planning (§10826.2(a))

This section describes actions and activities undertaken by TID to prepare for drought and effectively manage and mitigate the effects of surface water shortage. It includes the determination of water supply availability and drought severity, identification and analyses of potential vulnerability to drought, and opportunities and constraints for improving drought resiliency planning.

DETERMINATION OF WATER SUPPLY AVAILABILITY AND DROUGHT SEVERITY (§10826.2(A)(1))

Monitoring hydrologic conditions to assess available water supply is at the core of TID's drought management strategy. TID actively monitors forecasted precipitation and snow, accumulated precipitation and snow, runoff, reservoir storage, groundwater levels, availability of rented pumps, and instream flows. Key programs that TID implements to monitor and forecast water supply availability are described in Section 6 of the AWMP, and include:

- Airborne Remote Sensing for Snowpack (ARSS) Program
- Forecast-Coordinated Operations (F-CO) for the San Joaquin River watershed, and the TID Forecast-Informed Reservoir Operations (FIRO) Program
- Hydrologic Modeling of the Tuolumne River Watershed using the Hydrocomp Forecast and Analysis Model (HFAM)

Additional information sources include DWR snow surveys and other streamflow and groundwater level measurements. These data are incorporated into the District's models to forecast operations and inform decisions related to water supply availability. Real time flows, water levels, and storage data are also available on the TID website for various sites operated or used by TID (see **Section 7.4.12.3**).

Water reports describing hydrologic conditions are prepared by staff and reported to the Board of Directors at each Board meeting and can be found online at: <https://www.tid.org/about-tid/board-of-directors/tid-board-meetings/>.

In addition to monitoring water supply availability, TID reviews current and forecasted drought conditions on a local and regional scale. TID also has access to drought planning and mitigation strategies from a variety of sources, including the United States Drought Monitor, Western Regional Climate Center, DWR, and USBR. These resources improve TID's understanding of projected drought conditions, and help the District to improve its drought planning and response efforts.

Each year, the Board of Directors determines the amount of water available to growers for purchase that year (termed “available water”), and the fee schedule to be used that year (e.g. normal or dry year). **Table G.1** shows the available water and year type in recent years, as determined by the TID Board. These determinations are made based on the information described above, specifically: the projected runoff (including the possibility of the occurrence of consecutive dry years), the desired carryover storage, flows required to be delivered to the lower Tuolumne River, and the availability of rented pumps.

Table G.1. Recent Historical TID Available Water.

Year	Available Water (inches)¹	Year Type (Fee Schedule Used)	Percent of Full Supply
2011	48	Normal	100%
2012	30	Dry	63%
2013	34	Dry	71%
2014	20	Dry	42%
2015	20	Dry	42%
2016	36	Dry	75%
2017	48	Normal	100%
2018	48	Normal	100%
2019	48	Normal	100%
2020	42	Dry	88%
2021	34	Dry	71%
2022	27	Dry	57%
2023	48	Normal	100%
2024	48	Normal	100%

¹ Depth of water in inches available equally to each acre of land. In 2011-2012, this was termed the “allotment.”

POTENTIAL VULNERABILITY TO DROUGHT (§10826.2(A)(2))

Generally, TID water supplies have been sufficient in all but the driest years due to its conjunctive management of surface water and groundwater supplies and drought management actions. At least 48 inches of available water have been available to TID customers in more than half of all years since 1991 (**Figures G.1 and G.2**). In the remaining years, an average of approximately 33 inches of water (69 percent of full supply) was available to growers each year.

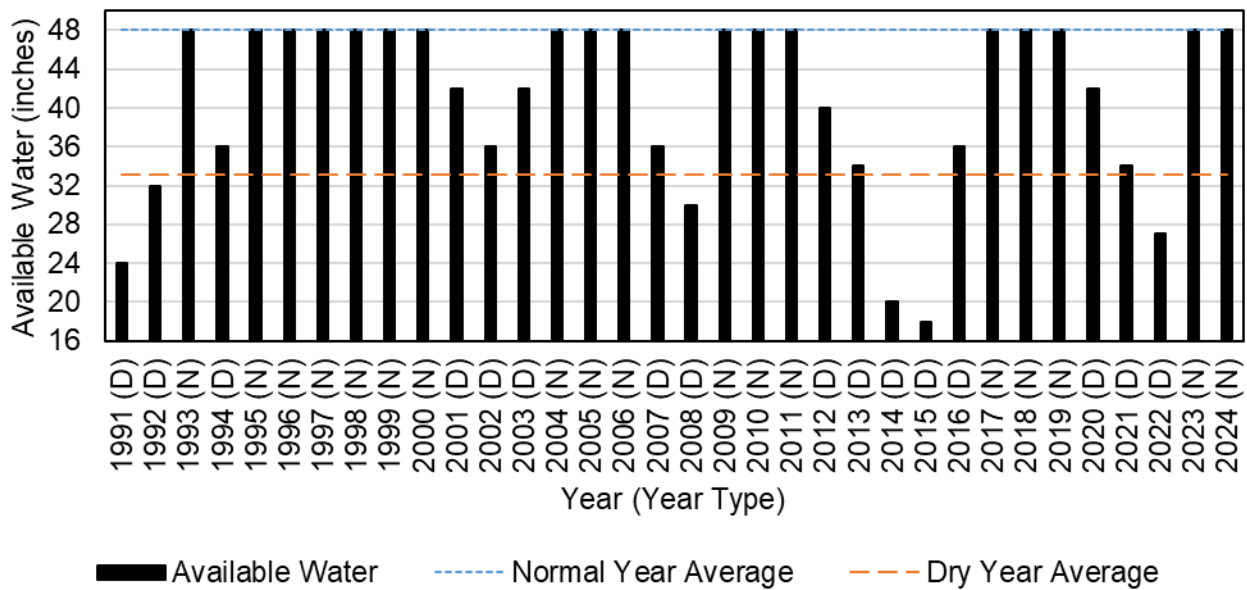


Figure G.1. Annual Available Water in TID, with Normal and Dry Year Averages.

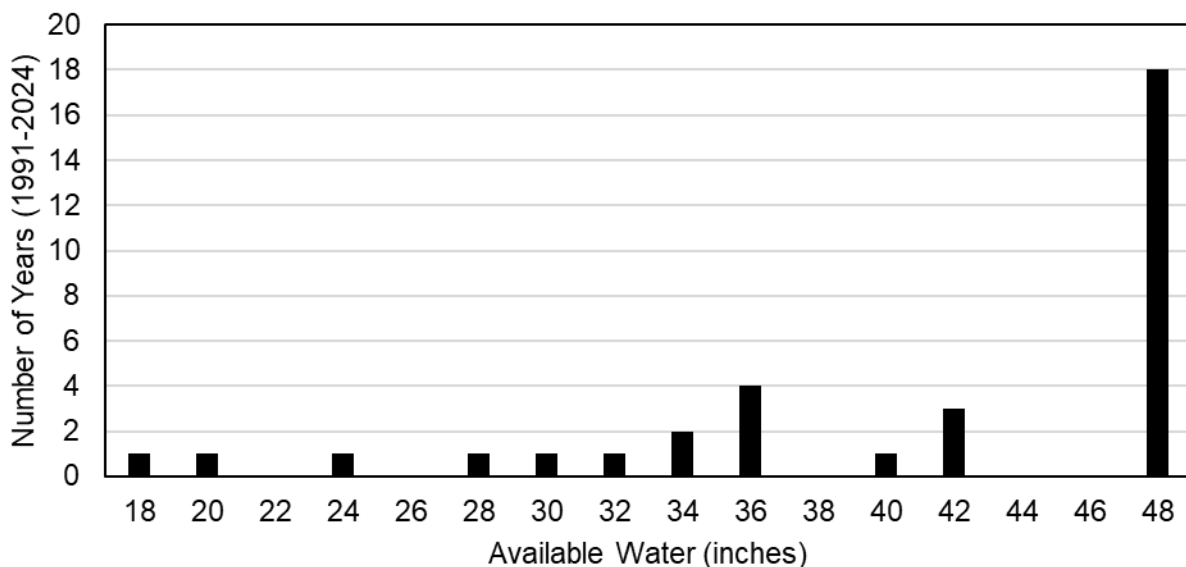


Figure G.2. Distribution of Annual Available Water in TID (1991-2024).

TID has reliable access to surface water supplies from the Tuolumne River. The District diverts surface water from the Tuolumne River under a series of pre- and post-1914 flow and storage water rights recognized by the State of California. While TID's surface water supply depends upon annual hydrologic and reservoir storage conditions, the hydrologic variance between years is somewhat mitigated by storage capacity at the Don Pedro Reservoir, which has an overall capacity of 2,030,000 AF. TID has access to 68.46 percent of the reservoir's available storage

above the minimum operating pool. As described in **Section 4.1.1** of the 2025 AWMP, surface water accounts for about 60 to 90 percent of TID's total water supply in a given year.

As described above and in **Section 7.4.12.3** of the 2025 AWMP, TID tracks real-time flows, water levels, and storage in the District, and utilizes these in conjunction with other data to implement Forecast Informed Reservoir Operations (FIRO) and forecast water supply from the upper watershed. TID's forecasting tools are used to strategically manage the District's surface water supplies and thereby protect TID's growers from potential vulnerabilities to future drought conditions.

TID supplements surface water releases by pumping groundwater from drainage wells and rented wells. Drainage wells owned by TID are used to lower groundwater levels in localized, high groundwater areas and to supplement other irrigation water supplies. Rented wells are owned by private parties or Improvement Districts, and are rented by TID to supplement irrigation supplies, particularly in drier years when surface water supplies are limited. Together, these wells are used to support TID's conjunctive management practices, supplementing reduced surface water supplies in dry years. These two additional supply sources reduce TID's potential vulnerability to drought.

Between 2020-2024, approximately 60,000 combined acres of pasture, alfalfa, corn, and grain were grown in TID each year to support the area's extensive dairy and livestock operations. While irrigation of these crops is important to support local dairy and livestock operations, these crops are more adaptable to reduced or variable water supplies than permanent crops. In recent years, the acreage of permanent crops (primarily almonds) has been increasing due to their demand and profitability. If this trend continues, it could present a new potential vulnerability to drought within the District.

DROUGHT RESILIENCE OPPORTUNITIES AND CONSTRAINTS: AVAILABILITY OF NEW TECHNOLOGY OR INFORMATION (§10826.2(A)(3)(A))

TID has prioritized implementation of new technology and improvements in data collection throughout the District for many decades. In recent years, TID has also made substantial, long-term improvements to distribution system infrastructure and operational practices that have increased operational efficiency and improved TID's drought resilience. Several highlights of TID's activities are described below and in **Section 7** of the 2025 AWMP:

- TID began installing and implementing its SCADA system in 1997. As of 2025, TID has implemented and upgraded SCADA monitoring equipment at 493 sites throughout the District. These sites monitor distribution system flows, water levels, gate openings, pumping, and spillage at regular intervals.
- In 2014, TID provided tablets to all Water Distribution Operators (WDOs), allowing them to remotely access SCADA data and operational information. Real-time access to SCADA data has helped WDOs improve the flexibility of deliveries to water users while maintaining distribution system efficiency and reducing spillage.
- TID implemented remote-control capabilities for drainage pumps, allowing WDOs to quickly monitor and operate pumps in response to real-time canal flows, further reducing spillage.

- During the 2014-2015 winter season, TID constructed a regulating reservoir and installed Total Channel Control (TCC) on Lateral 8. The reservoir storage capacity was expanded to 130 AF near the Highline Spill, providing storage for water that would have previously been spilled. With TCC on Lateral 8, TID is better able to match supply and demand, and thus provide better service with increased flexibility to customers on Lateral 8 while simultaneously reducing spillage.
- As of December 2025, TID has installed 153 new, permanent Rubicon flow measurement devices at sidegates, sites downstream of sidegates, and ID pipeline spillage sites throughout the District.
- TID installed the California Irrigation Management Information System (CIMIS) Weather Station #168 (Denair) in 2002, which was relocated and assigned a new station number (#206) in 2009. TID provides growers access to the CIMIS data on its website along with other weather information and forecasts (see **Section 7.4.12.2** of 2025 AWMP).
- TID actively monitors water supply data and forecasts, and provides the following information to growers (see **Section 7.4.12.3** of 2025 AWMP):
 - Real-time flows, water levels, and available storage for six sites via TID's Water Information Systems by KISTERS (WISKI) web portal (available at <http://wiskiweb.tid.org/index.htm>)
 - Current weather reports and Tuolumne River flows below La Grange Dam (<https://www.cnrfc.noaa.gov/graphicalRVF.php?id=MDSC1>)
 - List of seven online telemetry gauges used by TID, with links to each on the USGS National Water Information System website
 - Groundwater monitoring implemented by TID as part the Turlock subbasin Groundwater Sustainability Plan (GSP)
 - Results of the upper watershed collaborative project to implement Forecast Informed Reservoir Operations (FIRO), a reservoir-operations forecasting strategy that is communicated to the TID Board of Directors, and available to the public through the Board process
- TID together with the Turlock Subbasin Groundwater Sustainability Agencies (GSAs) has completed a Groundwater Sustainability Plan (GSP). TID has also supported development of a Groundwater Recharge Assessment Tool for the Subbasin, the installation of monitoring wells, and a Draft Programmatic Environmental Impact Report for the GSP. These efforts will further aid conjunctive management in the Subbasin and the TID service area.
- TID is currently working on a multi-year planning effort to improve irrigation service and modernize infrastructure, referred to as the TID Irrigation Facilities Master Plan (IFMP). The draft IFMP identifies and evaluates a suite of potential modernization projects for the District's water distribution infrastructure below Turlock Lake, including a variety of projects to construct regulating reservoirs and improve canal conveyance. Projects are being developed with the intent of allowing growers to adopt more efficient and productive on-farm irrigation systems, leading to increased water conservation over time as well as increased farm profitability. Projects have been conceptualized through input from TID staff at all levels and considering responses from 27 grower interviews that discussed existing and future cropping practices, irrigation systems, and water source preferences. The draft IFMP encompasses more than 50 work products, and will provide

a strategic plan for future modernization of the TID system in the coming years. TID may potentially pursue select projects proposed in the draft IFMP.

- TID has actively pursued the construction and evaluation of regulating reservoirs to improve water distribution efficiency and reduce operational spillage. Key efforts include the construction and expansion of the Lateral 8 Regulating Reservoir, evaluation of reservoir sites on the Ceres Main Canal, and development of the IFMP, which outlines over 50 modernization projects. These projects aim to enhance canal conveyance, support on-farm irrigation efficiency, and increase water conservation. TID has completed construction of the Ceres Main Canal Reservoir, finalized the design for the Lateral 5 ½ Reservoir, and obtained CEQA clearance for its construction.

TID plans to continue implementing new technologies to improve drought resiliency and operational efficiency and is continually exploring new technologies and information to achieve these ends. The largest impediment to implementing new technologies and disseminating information is cost, which can be restrictive to implementation in some cases. TID staff continually pursue grant funding to support these important efforts.

DROUGHT RESILIENCE OPPORTUNITIES AND CONSTRAINTS: AVAILABILITY OF ADDITIONAL WATER SUPPLIES (§10826.2(A)(3)(B))

As described previously, TID's water supplies have generally been sufficient in all but the driest years through conjunctive management of surface water and groundwater supplies combined with drought management actions. TID has historically increased groundwater pumping to deal with drought conditions, but has limited pumping to areas which do not risk negatively impacting nearby water users.

TID considers potential water transfers from other entities on a case-by-case basis; however, availability of transfers is limited and, even if available, costly. As described in **Section 4.1.3** of the 2025 AWMP, TID actively utilizes available recycled water and drainage water to supplement primary water supplies. Between 2020-2024, an average of 13,200 AF of other supplies¹ were used in TID each year.

In addition, TID is collaborating with the Modesto Irrigation District on an active cloud seeding program to help to increase available surface water supplies. TID will continue to evaluate the program, taking advantage of technological advances and/or increased cloud seeding opportunities to enable the Districts to maximize the water supply benefits of the program.

DROUGHT RESILIENCE OPPORTUNITIES AND CONSTRAINTS: OTHER PLANNED ACTIONS (§10826.2(A)(3)(C))

The District plans to continue evaluating opportunities to reduce potential vulnerability to drought. As opportunities are identified, planning efforts will incorporate feasibility studies, scoping, and implementation timelines for feasible opportunities.

¹ Other water supplies include treated wastewater, spill recovery, and tailwater, tilewater, and runoff that flow to TID canals.

As described in **Section 7.4.8** of the 2025 AWMP, TID has long implemented a robust conjunctive management program. TID's conjunctive management objectives support drought resilience by: 1) maintaining a sustainable groundwater system through continued use of surface water for deliveries and recharge in normal and wet years, and 2) maintaining water deliveries in dry years through increased groundwater pumping.

As a member of the West Turlock Subbasin GSA, TID has adopted and is implementing the Turlock Subbasin Groundwater Sustainability Plan (GSP). The GSP identified actions needed to achieve groundwater sustainability in the Turlock Subbasin, providing support for ongoing conjunctive use of surface water and groundwater supplies in the subbasin and improving drought resilience in the future.

One additional action to promote drought resilience, which has been implemented in the past and which TID continues to implement, is encouragement of on-farm water stewardship to support drought resilience. Specific actions taken by TID include:

- Education and Outreach to Growers
- Enforcement of TID Rules and Regulations
- Volumetric Pricing, and Increased Cost per Unit of Water Delivered in Dry Years
- Reduction of Available Water in Dry Years
- Reduction in Season Length in Dry Years

These actions are described in the 2025 AWMP, and summarized below.

Education and Outreach to Growers

TID regularly provides educational resources and conducts outreach activities to support efficient water management by its irrigation customers (see **Section 7.4.12** of the 2025 AWMP). During drought, TID increases these efforts to further encourage on-farm water conservation and to keep growers informed of any changes that are made to TID policies and practices to manage limited water supplies. The TID website offers resources and educational information in its "Irrigation Information" and "News & Resources" sections². In addition to public notices, press releases, news, and educational materials, TID offers a wealth of strategies to improve irrigation efficiency and drought resilience. Sample resources that TID has provided to the public and to growers are listed below.

TID General Resources

The following TID general resources are available on the TID website.

- TID Irrigation Information page
- TID Groundwater Management page
- TID Irrigation Tips page
- TID Water Measurement page

² Irrigation Information: <https://www.tid.org/irrigation/irrigation-information/>. News & Resources: <https://www.tid.org/news-and-resources/>. Accessed February 18, 2026.

- TID Current Projects page
- “The Grower” newsletter

Grower Resources

The following grower resources are available on the TID website.

- Drought Resources page

Enforcement of TID Rules and Regulations

TID’s Irrigation Rules (**Appendix E** of the 2025 AWMP) require that all water be applied efficiently and be used in a reasonable and beneficial manner. During an irrigation delivery, the irrigator is responsible for the water at all times after it leaves the TID distribution system (Rules 4.1.3 and 4.1.4). Irrigators who waste water intentionally or as a result of carelessness, improper field preparation, or neglected facility maintenance may be refused TID water until the cause of the waste is remedied (Rule 4.2.2).

Additional information about specific rules, enforcement actions, and appeals processes are described in **Section 2.2.4.2** of the 2025 AWMP, and in the section below titled “Methods and Procedures for Triggering and Enforcing Water Shortage Response Actions (§10826.2(B)(2)).”

Volumetric Pricing, and Increased Cost per Unit of Water Delivered in Dry Years

Beginning in 2013, TID implemented a new water rate structure that charges customers based, in part, on the volume of water delivered (see **Section 7.3** of the 2025 AWMP). Originally, TID’s volumetric pricing structure included separate tiered-pricing structures for normal and dry years, with four water rate tiers in each year type that were defined based on the amount of water delivered per acre. The cost per acre-foot of water delivered increased as growers moved from lower to higher tiers. A fixed fee per acre was also included. Effective in 2025, TID approved a 6.2% rate increase spread over three years. Tiers 1-3 were consolidated into a single rate to encourage use of surface water in years it is available, while Tier 4 remained at \$20/AF. The fixed fee increased in dry year types..

The 2025 water rate structure is as follows:

- Normal Year
 - Fixed Charge: \$60 per acre
 - Available Water Rate: \$2.70 per AF, up to available water
 - Water Rate Over Available Water: \$20 per AF, over available water
- Dry Year
 - Fixed Charge: \$68 per acre
 - Available Water Rate: \$2.70 per AF, up to available water
 - Water Rate Over Available Water: \$20 per AF, over available water

Total irrigation rates as a function of usage are illustrated in **Figure G.3**. As indicated, during dry years the cost for a given volume increases, with the aim of encouraging on-farm conservation and other grower decisions to reduce demand.

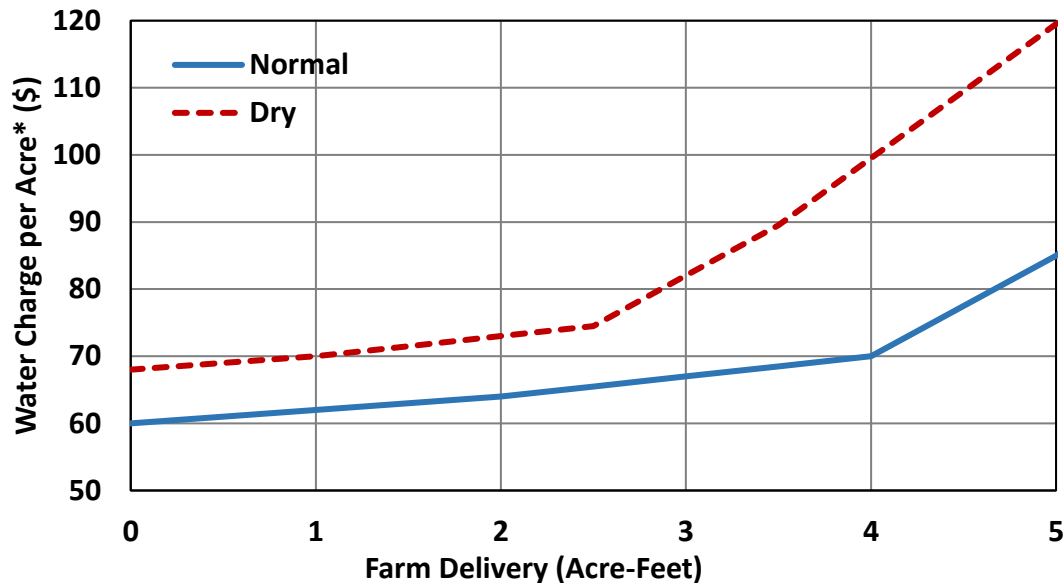


Figure G.3. TID Normal and Dry Year Irrigation Rates as a Function of Usage.

** Fixed charge (charge at 0 acre-feet) is a function of acreage. Volumetric charges (all charges for farm deliveries above 0 acre-feet) are a function of usage. This figure shows fixed charges for a one-acre parcel.*

Reduction of Available Water in Dry Years

As described previously, the District's Board of Directors considers and reviews staff recommendations to determine the annual water availability for growers, expressed as water available per acre, up to 48 inches. In dry years when water supply is reduced, less than 48 inches is available. Reducing available water supplies directly reduces customer demand, as described in the section "Policies and Processes for Water Shortage Declaration and Water Shortage Allocation and Implementation (§10826.2(B)(1)), below. During the 2012-2016 drought, available surface water supplies ranged from 42 percent to 75 percent of full supply, with an average availability of 59 percent of full supply. Some growers responded to the reduction in available water by switching to drought resistant sorghum. In 2014, a new crop code for sorghum was added to TID's crop tracking system at the request of TID's Call Center in response to growers increasingly reporting their crop as sorghum.

Reduction in Season Length in Dry Years

The District's Board of Directors determines the irrigation season start and end dates considering grower preferences and staff recommendations. In dry (reduced water supply) years, the season start and end dates are often adjusted to reduce the season length. In 2014 and 2015, the irrigation seasons were 182 days each, the two shortest seasons in the last 34 years (1991-2024). The average season length was approximately 230 days for 2020-2024.

Drought Response Planning (§10826.2(b))

This section describes actions and activities undertaken by TID in response to drought to address surface water shortage. It includes discussion of the policies and processes for declaring water shortage and implementing water shortage allocations (also described in **Section 2.2.4** of the 2025 AWMP), the methods and procedures for the enforcement or appeal of triggered shortage responses, the methods and procedures for monitoring and evaluating the drought management plan, the communication protocols and procedures used by TID during drought, and the potential financial impacts of drought and proposed measures to overcome those impacts.

POLICIES AND PROCESSES FOR WATER SHORTAGE DECLARATION AND WATER SHORTAGE ALLOCATION AND IMPLEMENTATION (§10826.2(B)(1))

The District's water shortage allocation policies are described in **Section 2.2.4** of the 2025 AWMP. Each year, the District's Board of Directors determines the annual "available water" – the amount of water per acre available to growers for purchase – based on staff recommendations. Staff create these recommendations by developing and reviewing runoff projections and projected carryover storage and by considering past operations, flows required to be delivered to the lower Tuolumne River, and the availability of rented pumps.

In dry years when water supply is reduced, less than 48 inches per acre is available to growers. In establishing the available water in a dry year, the District evaluates water supplies as if it is the first dry year of a multiple year dry cycle. The recent 2012-2016 drought is used as the "drought of record" for planning purposes. Other significant dry periods are also considered, including 1976-1977 and 1987-1992 and 2020-2022. During the 2012-2016 drought, available water ranged from a maximum of 34 inches in 2013 (71 percent of a full supply year) to 20 inches in 2015 and 2016 (42 percent of a full supply year), as indicated in **Table G.1**. Since 2012, TID has implemented a tiered, volumetric pricing structure to comply with SBx7-7 water pricing requirements. The pricing structure is an increasing block rate structure (combined with a fixed charge) with two different fee schedules, one for "normal" water years and one for "dry" years. As shown in **Figure G.3** of this appendix and in **Section 2.2.3** of the 2025 AWMP, the "dry" year fee schedule is set at a higher rate to encourage conservation and to help recover the additional pumping costs incurred in dry years.

Historically, growers who paid the District's water charge were provided with access to the same amount of available water, regardless of crop type. The current rate schedule is designed to act in a similar manner. Payment of the fixed charge provides growers with access to purchase the amount of water available that year, regardless of crop type. This benefits the District's users because a large proportion of the field crops in this region are grown in conjunction with local dairy operations which have a year-round water demand, not unlike orchard crops in the area.

OPERATIONAL MODIFICATIONS TO INCREASE EFFICIENCY

During drought, TID modifies operations through a combination of strategies to increase operational efficiency with the primary goal of reducing operational spillage from TID canals and laterals.

During dry years, WDOs increase efforts to reduce spillage by monitoring spillage more closely, by making more frequent adjustments to water level control structures and lateral headings, and by using pumps to more precisely match supply with demand.

In all but extreme drought years, TID increases groundwater pumping to supplement surface water supplies in the canal system, providing increased flexibility for WDOs to more precisely match water supply to customer demands and further reduce spills. This use of pumps, particularly in the lower distribution system (i.e. west of the Ceres Main Canal), allows WDOs to more rapidly adjust canal flows to match demand and reduce spills that result from irrigation head changes and varying delivery amounts that can cause fluctuations in canal flows. This strategic use of groundwater supplies enables the District to maximize surface water supplies, reserving surface water in Don Pedro Reservoir that would otherwise have spilled and making it available for delivery later in the season or in subsequent dry years.

During the 1987-1992 drought, these actions resulted in a substantial decrease in operational spills. TID has continued to rely on these extraordinary operational practices in subsequent drought years. Notably, during the dry period of 2007-2009 operational spills were decreased to an average of less than five percent of total supply. Similarly, during the onset of the recent 2012-2016 drought, operational spills decreased each year to less than five percent of total supply in 2014-2015.

Another operational strategy employed by TID to increase operational efficiency in drought years is to modify targeted water levels in Turlock Lake. By operating the Lake at reduced water levels during drought, losses are reduced. In 2015, TID operated Turlock Lake at approximately 50 percent capacity to reduce seepage and evaporation.

TID's internal water transfer policies additionally allow growers to transfer water between parcels that they own or rent. This program enables growers to maximize available supplies for use in meeting crop water requirements and is facilitated by TID WDOs, who convey the transferred water through the TID distribution system as needed.

Together, these operational modifications allow TID and its customers to effectively respond to drought while minimizing the potential impacts on available water supplies and demand.

METHODS AND PROCEDURES FOR TRIGGERING AND ENFORCING WATER SHORTAGE RESPONSE ACTIONS (§10826.2(B)(2))

TID does not rely on mechanistic, pre-determined triggers to implement drought management actions. Rather, the Board of Directors considers data that it receives on an ongoing basis as well as recommendations from TID staff based on assessment of current and projected water supply conditions on an annual basis to set an annual available water amount. Based on Board decisions influenced by the amount of water available each year, water policies are modified and drought management actions are implemented and adjusted as needed. This approach to managing water supplies and demands during shortages allows TID flexibility to maximize the long term reliability, quality, and affordability of irrigation water supplies.

TID enforces its Irrigation Rules (**Appendix E** of the 2025 AWMP) in all years to ensure that all water is applied efficiently and is used in a reasonable and beneficial manner. The section

“Enforcement of TID Rules and Regulations” above describes specific rules and enforcement actions that prevent wasteful or improper use of water in all years.

In the face of drought, TID increases enforcement of water regulations to prevent unauthorized use of water. Landowner or irrigator failure or refusal to comply with the TID rules and regulations may lead to suspension of water delivery until the issue is resolved (Rule 10.1). The Water Distribution Department Manager is authorized to issue a Notice and Order or oral or written warning to any irrigator or landowner in violation of TID regulations (Rule 10.2.1). The landowner or irrigator has 10 calendar days from the service date of the Notice and Order to file a written appeal to the General Manager or Board of Directors, depending on type of notice, after which all rights to a hearing are waived (Rule 10.2.2). Water deliveries may be terminated immediately in certain circumstances (Section 10.3). These circumstances and the appeal process are described in detail in the TID Irrigation Rules in Part I, Section 10 (**Appendix E**).

Once an order or decision has become final, the irrigator or landowner has seven calendar days to commence corrective action or repair and must pursue the action with sufficient diligence to meet the time established for compliance (Rule 10.5.4). When the landowner or irrigator returns to full compliance with all regulations, the individual will resume eligibility to receive water deliveries.

During the 2012-2016 drought, the TID Board of Directors adopted the following penalties for unauthorized use of water:

- First offense - \$1,000 fine and water taken will be billed at the highest tier amount.
- Second offense - Potential loss of water on all parcels owned or rented for the remainder of the season.

MONITORING AND EVALUATION OF THE DROUGHT MANAGEMENT PLAN (§10826.2(B)(3))

Continuous monitoring of hydrologic conditions, water supply, water deliveries, operational efficiency and other metrics is an important part of TID’s water management in any year, but especially in times of drought. TID continually monitors changes in water supply availability and drought severity, allowing the District to adapt and align its water management efforts per the Drought Management Plan to best distribute and manage available water resources for the mutual benefit of lands within the District’s service area boundaries. TID’s water reports, extensive SCADA network, array of reservoir and flow monitoring sites, and implementation of models to forecast water supply from the upper watershed are just a few of the many resources TID uses to proactively monitor drought resilience and response efforts.

Review of these metrics following a period of drought allows TID to evaluate the cumulative impacts of drought and the overall effectiveness of the DMP over consecutive dry years. Analyses of past drought periods also provide opportunities to revise the DMP and improve drought management within the District moving forward. To this end, the “Evaluation of 2012-2016 Drought” section below includes a review of the longest drought, its effects in TID, and the overall effectiveness of the DMP during the 2012-2016 drought.

COMMUNICATION PROTOCOLS AND PROCEDURES (§10826.2(B)(4))

This section describes communication protocols and procedures within TID as well as broader communication and collaboration efforts with regional stakeholders during times of drought.

Communication Protocols and Procedures within TID

TID strives to have clear communication protocols and procedures with landowners and customers within the district and recognizes the importance of this, especially in times of drought. Typically, informational materials are made available through multiple channels of communication. TID communicates through the District website, delivers announcements and notices through physical mail and email, and posts announcements at the TID office.

Communication materials are made available to irrigation customers at the front office and on the TID website. Special announcements, public notices, and press releases from the Board of Directors are also made available on the TID website (<https://www.tid.org/news-and-resources/public-notices/>; <https://www.tid.org/news-resources/news-media/#advgb-tabs-tab1>). TID provides growers with the CIMIS website information and a web link to CIMIS tutorials and station data on the TID website (www.tid.org/irrigation/irrigation-information). TID also provides links to additional information related to TID, reservoir and river conditions, drought resources, statewide conditions, and more on a Drought page on the TID web site (<https://www.tid.org/irrigation/drought/#drought-resources>).

Finally, TID office staff and WDOs are available during business hours to answer questions related to water supply availability or drought management from landowners and customers.

Coordination and Collaboration with Regional and Statewide Entities

Extensive coordination and collaboration with others is a vital component of TID operations. The District reports data to the California Energy Commission, the California Department of Water Resources, and other governmental entities, as necessary. TID also partners with cooperating entities at Don Pedro Reservoir on watershed studies and other efforts surrounding Tuolumne River water supply and demand, including instream flows, snowpack, agricultural and urban demand, climate change, and other considerations. TID also works with applicable regulatory agencies that affect the flexibility with which TID can store and deliver water.

One example of such coordination is TID's role in the formation and ongoing operation of the West Turlock Subbasin Groundwater Sustainability Agency (WTSGSA), an association of local municipal water systems and agencies located in the western portion of the Turlock Subbasin. As a member of the WTSGSA, TID is actively involved in subbasin-wide SGMA-implementation efforts. Both the WTSGSA and the East Turlock Subbasin GSA have adopted and are implementing the Turlock Subbasin Groundwater Sustainability Plan (GSP).

Additionally, the District meets with local cities and counties regarding groundwater resources, water conservation and recycling projects, and public education and outreach.

POTENTIAL FINANCIAL IMPACTS OF DROUGHT AND PROPOSED DISTRICT MANAGEMENT MEASURES (§10826.2(B)(5))

Increased expenditures during times of drought result from increased public outreach activities and increased groundwater pumping costs. District staff members spend significantly more time providing irrigation customer service and outreach to the public through increased grower meetings, outreach programs, and drought workshops. The District has also historically operated rented pumps and drainage pumps to help supply water deliveries, especially in dry years.

The increased expenditures to implement drought management actions are mitigated by reducing expenditures and focus on capital improvements and maintenance. This places more emphasis on system operations and demand management during times of drought.

TID also increases revenue during drought years through its tiered water rate structure. In dry years, TID increases the fixed (per-acre) charge for all customers and increases the volumetric charges at a higher rate per unit of water use.

Finally, TID periodically reviews the financial status of the District and potential impacts of drought to identify opportunities to improve the financial resiliency of the District during periods of drought.

Evaluation of the 2012-2016 Drought

The following sections describe the impacts of the 2012-2016 drought on water supply and water demand in TID. Water supply and demand in 2011 are also provided for comparison with a normal, full-supply year preceding the drought period.

This discussion also examines the effectiveness of TID's past drought resilience and drought response efforts, identifies lessons learned from the drought, and provides context for planning future actions.

DROUGHT IMPACTS ON WATER SUPPLY

TID's water supplies in 2011-2016 are discussed to illustrate the effect of actions taken by TID and its customers to manage available water supplies during drought. The years 2012-2016 represent a historic, multi-year drought, while 2011 represents a normal year with full supply. All sources of supply identified in the AWMP water budget are summarized below, including Turlock Lake releases, District pumping (both rented pumping and drainage pumping), private pumping, and other supply sources (tilewater drainage, tailwater runoff, precipitation runoff, recycled wastewater, and spillage recovery).

Turlock Lake releases generally decreased during the drought, except in 2016 (**Figure G.4**). In 2011, the total annual releases from Turlock Lake exceeded 588,000 acre-feet. In 2012 and 2013, releases were around 470,000 acre-feet, more than 100,000 acre-feet lower than the total releases in 2011 but higher than the 1991-2019 dry year average of about 439,000 acre-feet. In 2014 and 2015, Turlock Lake releases were reduced to around 300,000 acre-feet, the lowest volumes in the 1991-2019 water budget period. However, in 2016 the releases from Turlock Lake increased again to nearly 400,000 acre-feet.

Total district pumping – the combined total drainage and rented pumping by TID – increased from 68,000 acre-feet in 2011 to over 110,000 acre-feet in 2012 and 2013, the first two years of the drought (**Figure G.5**). The total district pumping decreased in 2014 to about 88,000 acre-feet, and decreased again in 2015 to about 56,000 acre-feet as TID reduced pumping in certain areas to reduce the potential impacts on local groundwater levels. The total pumping then increased again to 75,000 acre-feet in 2016, the final year of the drought period.

The total private pumping in the TID service area was lowest in 2011, the last full supply year before the drought, and only increased slightly in 2012 and 2013 (**Figure G.6**). In response to reduced District pumping, private pumping increased to over 103,000 acre-feet in 2014 and over 125,000 acre-feet in 2015. As TID's surface water and groundwater supplies increased in 2016, pumping decreased to just over 60,000 acre-feet.

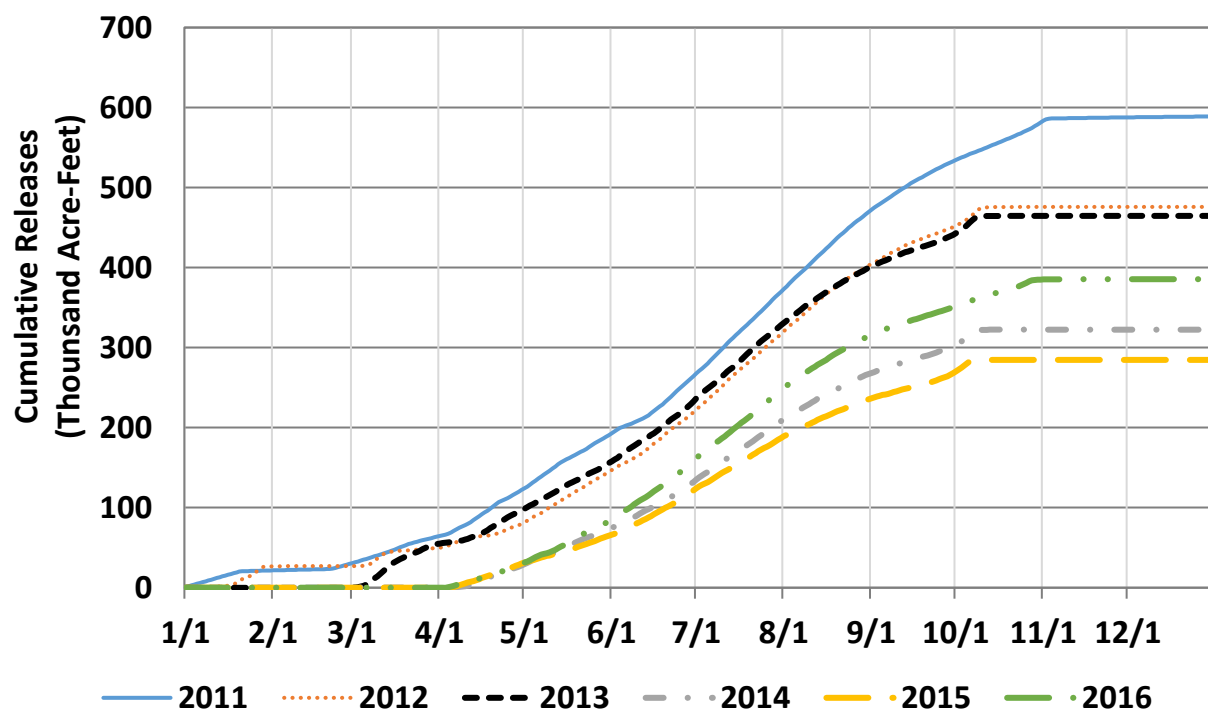


Figure G.4. Daily Cumulative Turlock Lake Releases, 2011-2016.

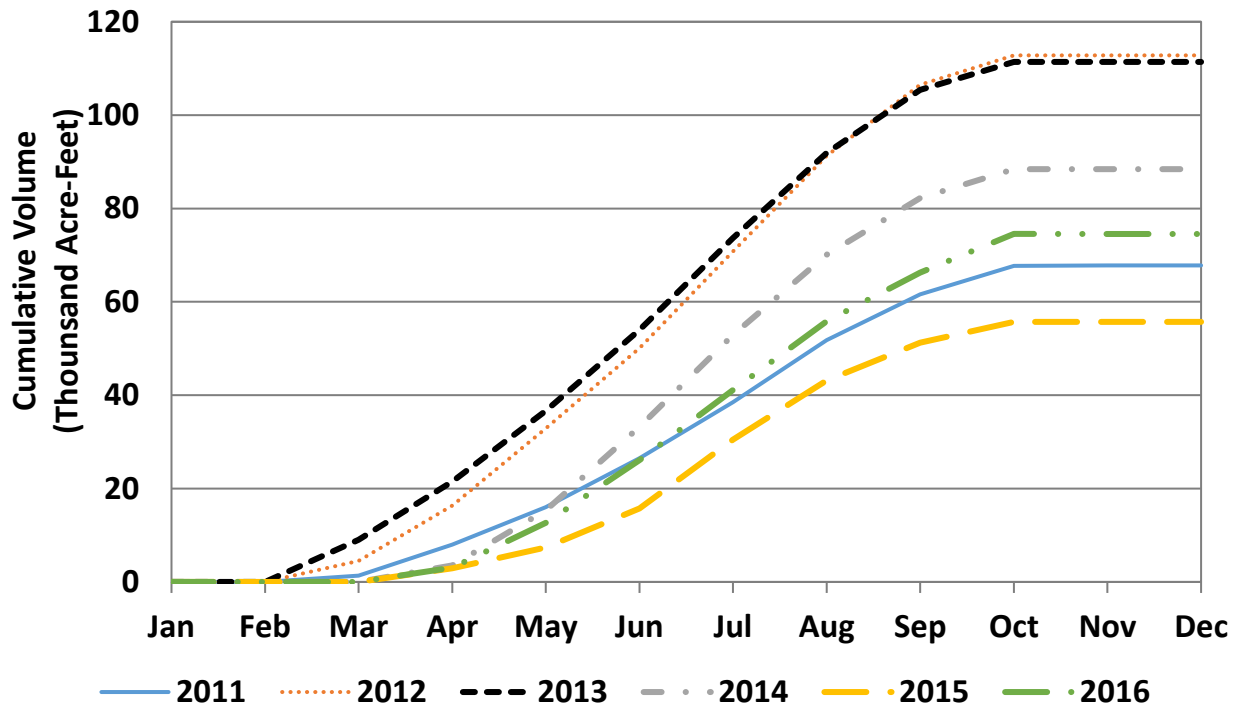


Figure G.5. Monthly Cumulative District Pumping, 2011-2016.

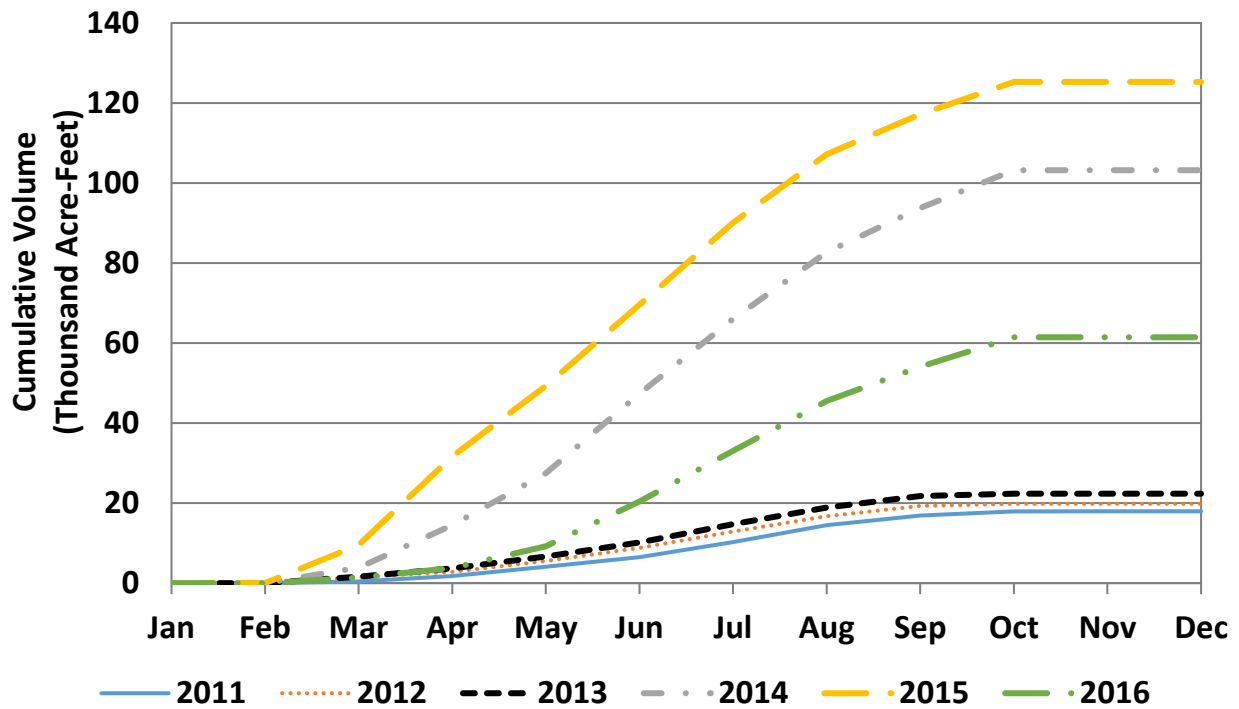


Figure G.6. Monthly Cumulative Private Pumping, 2011-2016.

Other sources of water supply available to TID customers include tilewater drainage, tailwater runoff, precipitation runoff into canals, spillage recovery, and recycled wastewater. These combined other water supplies were greatest in 2011, the last full supply year, and decreased more than 30 percent to less than 12,000 acre-feet in 2014 and 2015 (**Figure G.7**). As available water supplies provided by the District decreased during drought periods, other recycled water supplies that originated from these supplies, namely spillage, and flood irrigation, likewise decreased. In 2016, other water supplies increased again to nearly 15,000 acre-feet as available water and District water supplies increased.

Altogether, the total water supply was greatest in 2011, at nearly 700,000 acre-feet, and lowest in 2015, at approximately 480,000 acre-feet (**Figure G.8**). The total supply in TID in 2012-2013 only varied from total supply available in 2011 by 10-12 percent (70,000 to 80,000 acre-feet), indicating that TID's drought planning and response efforts are successful in weathering short droughts. However, by the third and fourth years of the drought in 2014 and 2015, reductions in surface water supply were compounded by reductions in TID groundwater production while private pumping increased. In 2016, the fifth year of the drought, both Turlock Lake releases and District pumping increased, while private pumping decreased.

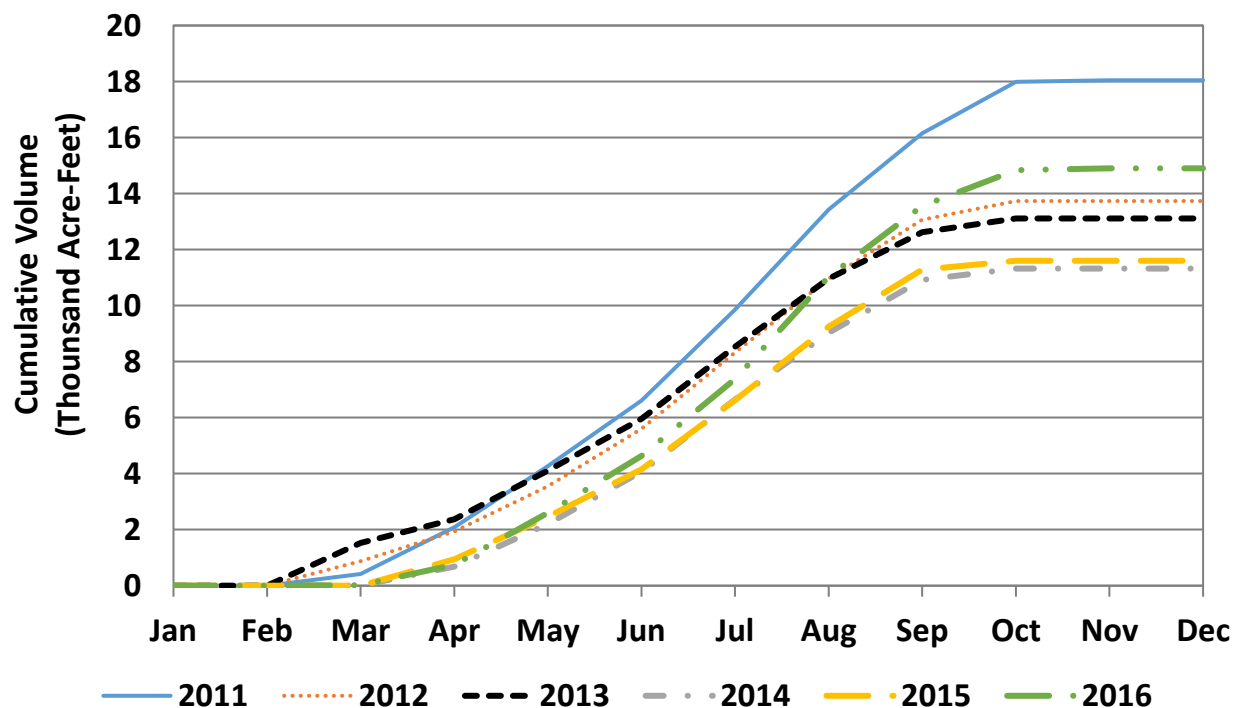


Figure G.7. Monthly Cumulative Other Supply, 2011-2016.

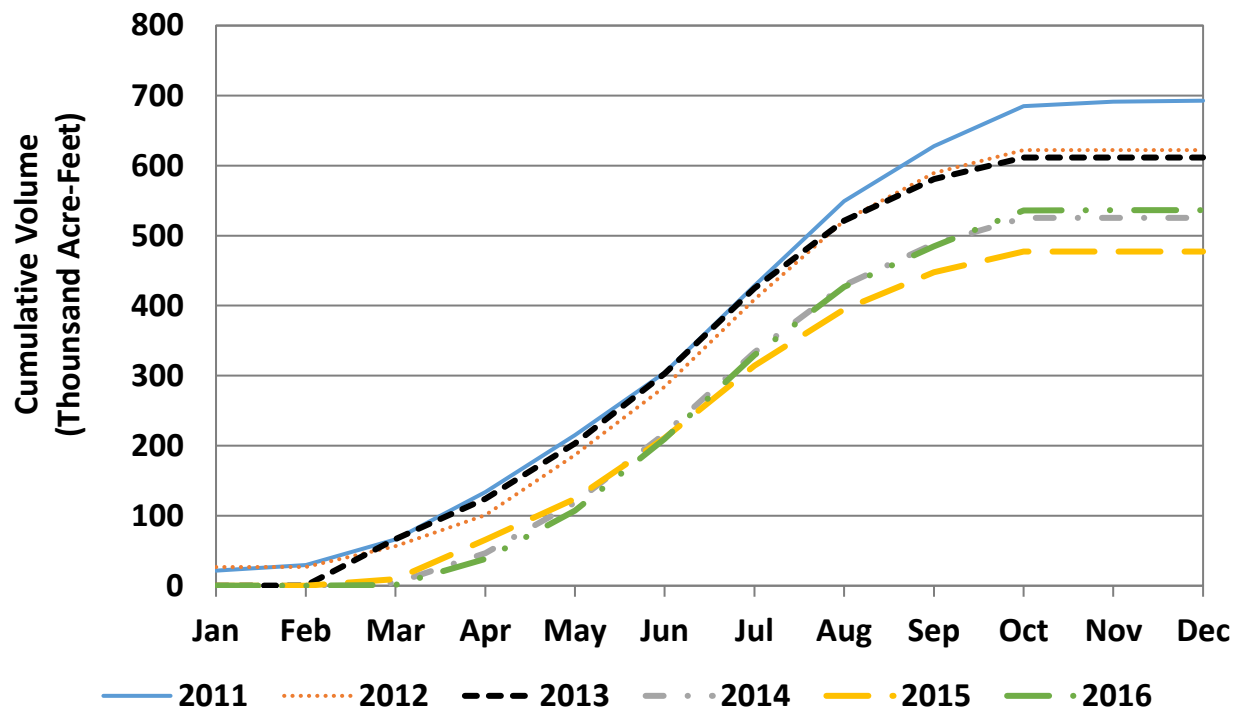


Figure G.8. Monthly Cumulative Total Supply, 2011-2016.

DROUGHT IMPACTS ON WATER DEMAND

Water demand in the TID service area from 2011-2016 is discussed to illustrate the effect of actions taken by TID and its customers to manage water use during drought. The years 2012-2016 represent a historic, multi-year drought, while the year 2011 represents a normal year with full supply. Overall demand is based on several parameters:

- monthly farm deliveries (as quantified through the TID water balance), a measure of farm surface water demand
- reference evapotranspiration (ET_o), a measure of atmospheric water demand
- crop evapotranspiration of applied water (ET_{aw}), a measure of agricultural consumptive water demand.

The total volume of farm deliveries by TID were similar in 2011, 2012, and 2013, with approximately 490,000 acre-feet delivered each year (**Figure G.9**). The similarity in total delivery volumes between 2011 and the first two years of drought highlights that TID's drought planning efforts are successful in weathering short droughts. In the third and fourth years of the drought, the annual volumes of TID farm deliveries were reduced by 25-40 percent from the volume in 2011, as TID's Board limited the water available to growers to just 20 inches per acre. In 2014 and 2015, approximately 364,000 acre-feet and 295,000 acre-feet were delivered, respectively. In 2016, the total farm deliveries increased to just over 400,000 acre-feet as TID's water supplies increased and the amount of available water also increased to 36 inches per acre. Notably, total deliveries decreased from pre-drought levels to a lesser extent than did total

supplies. This was due primarily to increased efforts to improve water use efficiency, namely reduction in spillage and increases in on-farm irrigation efficiency.

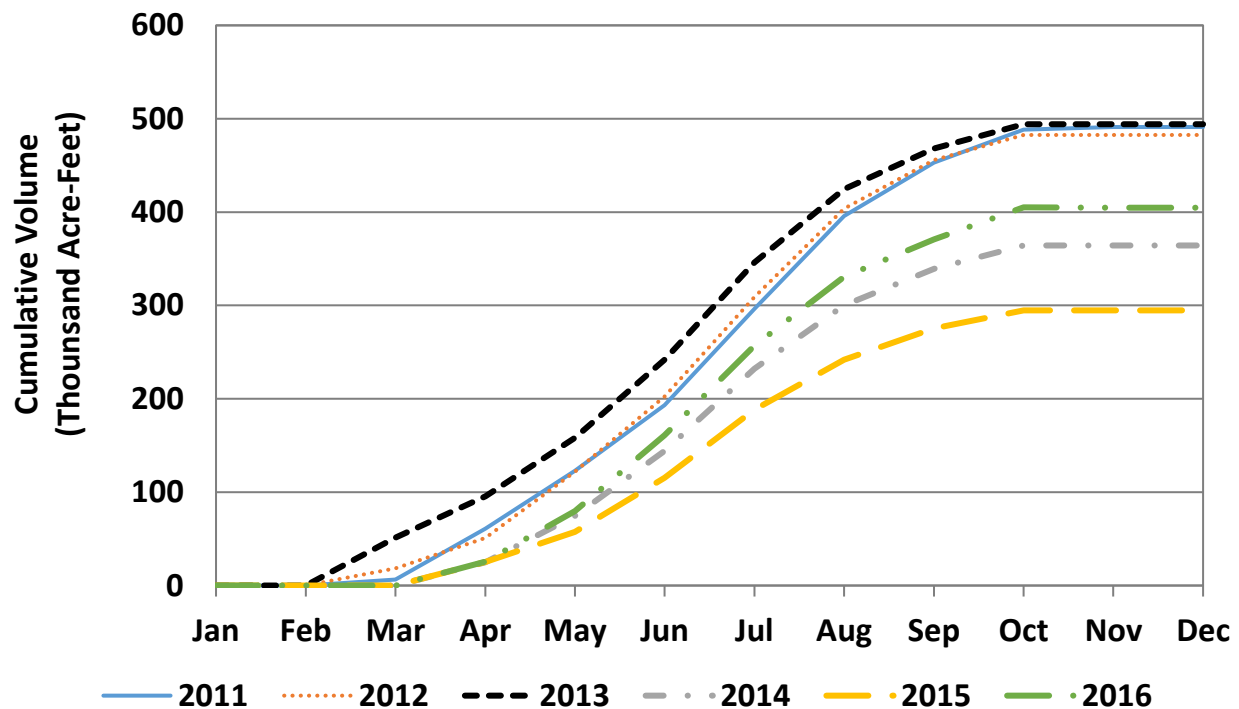


Figure G.9. Monthly Cumulative TID Farm Deliveries, 2011-2016.

Daily cumulative atmospheric water demand, ET_o , for 2011-2016 is shown in **Figure G.10**. Total ET_o , as measured at the Denair and Denair II CIMIS stations, was essentially the same in 2011 and 2012, at 51.0 and 51.9 inches, respectively. Total ET_o during 2013-2016 was between 55.5 and 57.1 inches each year, about 10 percent higher on average than in 2011 and 2012.

The total volume of agricultural consumptive water demand, ET_{aw} , in the TID service area was lowest during 2011, the last full supply year, totaling nearly 280,000 acre-feet. Agricultural ET_{aw} increased to between approximately 318,000 acre-feet and 365,000 acre-feet in during the 2012-2016 drought, driven by increased ET_o and shifts in agriculture toward higher-demand permanent crops such as orchards (**Figure G.11**).

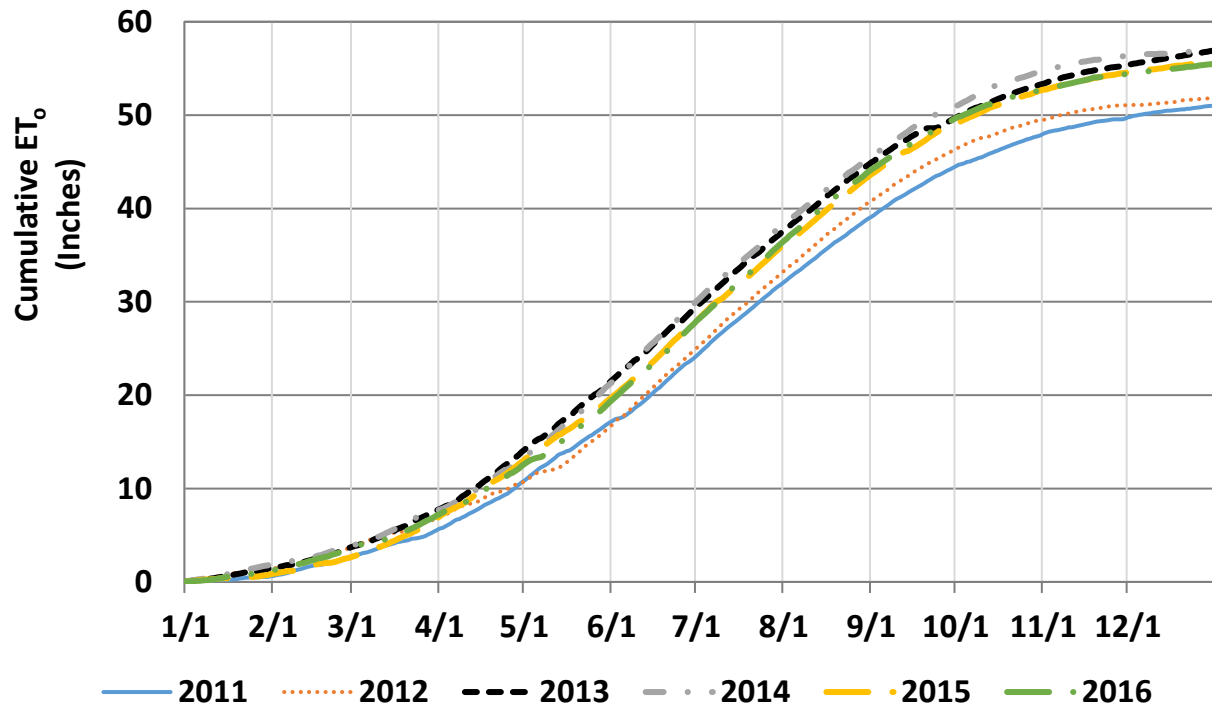


Figure G.10. Daily Cumulative ET₀, 2011-2016.

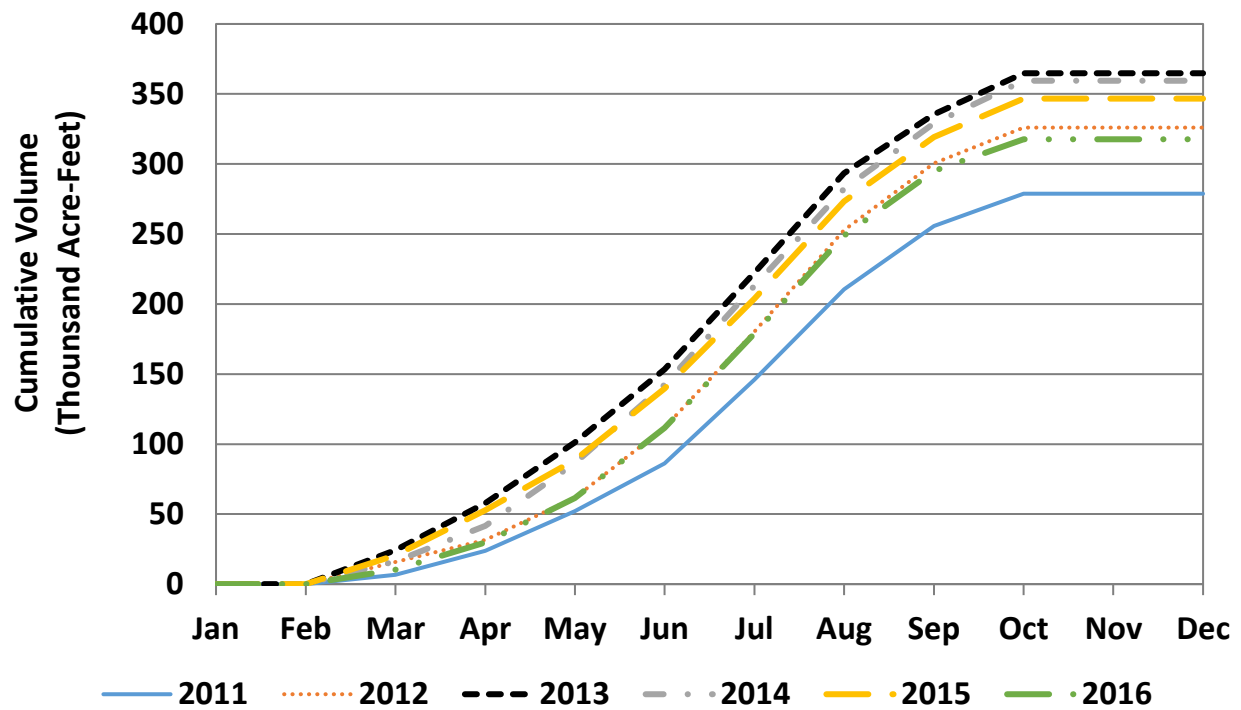


Figure G.11. Monthly Cumulative crop ET_{aw}, 2011-2016.

EFFECTIVENESS OF TID DROUGHT PLANNING EFFORTS IN 2012-2016

The evaluation of drought impacts on TID's water supply and water demand generally indicates that TID's ongoing drought planning efforts are highly effective in response to shorter droughts, and generally support growers in weathering and recovering from potential impacts of longer droughts when District supplies are limited.

In 2012-2013, the total water supply in the TID system was reduced by 10-12 percent compared to 2011 (**Figure G.8**) – the last full supply year preceding the 2012-2016 drought – yet TID was able to supply nearly the same total volume of farm deliveries to growers as in 2011 (**Figure G.9**). Reductions in surface water supply during 2012-2013 were partly offset by increased District pumping, consistent with the District's overall conjunctive management strategy. The effects of the supply reductions on growers were also mitigated by enhanced system and operational efficiency on the part of TID's WDOs. Consequently, private pumping volumes increased only slightly in 2012-2013 (**Figure G.6**), suggesting that growers' irrigation needs were largely satisfied by TID during the early drought period.

As the drought continued into 2014-2015, TID reduced both surface water releases and groundwater pumping to prevent undesirable effects on local groundwater levels in the subbasin. As a result, total supplies in the TID system were reduced by 25-30 percent compared to 2011. Likewise, TID's Board of Directors restricted the amount of available water to 20 inches per acre, resulting in a 25-40 percent reduction in farm deliveries compared to 2011 (**Figure G.9**). While the reduced deliveries contributed to substantial increases in private pumping in 2015 (**Figure G.6**), the groundwater available to growers was also buffered by years of conjunctive management and recharge in TID.

As TID's total supplies recovered somewhat in 2016, the total volume of farm deliveries made by TID also increased while private pumping decreased. These shifts suggest that although the severe drought and restricted water supplies in 2015 pushed growers to pump more groundwater for irrigation, the availability and affordability of TID's supplies, even at the higher rates charged during dry years, strongly incentivize conjunctive management.

Cropping and ET_{aw} volumes in TID also suggest that TID's drought planning efforts are effective in sustaining crop and livestock production even in the midst of drought. TID supplies water to large areas of permanent crops and pasture, alfalfa, and grain crops that support local dairies, all of which requires a steady annual water supply. Despite the large decreases in total water supply between 2013 and 2014-2015 (**Figure G.8**), the volume of total agricultural ET_{aw} in TID decreased by only about 1 to 5 percent (5,000 to 18,000 acre-feet) from the total ET_{aw} in 2013. This is likely attributable in part to increases in on-farm water use efficiency, enhanced grower outreach and education, and increased distribution system efficiency.

These findings indicate TID's drought planning efforts are highly effective in response to shorter droughts, and are generally supportive of managing the impacts of longer droughts on crop production when District supplies are limited.

Key practices and policies that were especially critical to TID's drought resilience and drought response in 2012-2016 include, but are not limited to:

- **Conjunctive management in all years.** TID practices conjunctive management of surface water and groundwater supplies in all years, supplementing surface water releases

when needed by strategically pumping groundwater from drainage wells and rented wells selected based on need, location, cost, and water quality. During normal years, TID incentivizes the use of available surface water supplies (described below), thereby supporting groundwater recharge. During dry years, TID increases groundwater pumping, as supplies allow, to balance available surface water supplies with carryover storage requirements. TID also utilizes supplemental groundwater pumping to help conserve water by reducing canal spillage. This is done by purposely releasing less surface water than is needed for irrigation into the head of each canal, and pumping groundwater into the lower sections of a canal to make up the difference. Conjunctive management of available surface water and groundwater supplies, particularly shallow groundwater, provides greater flexibility to system operators to meet irrigation demand, while reducing distribution system spillage.

- **Affordable irrigation water rates, and tiered volumetric pricing set based on water supply availability (since 2013).** For many years, TID has offered irrigation water to its customers at affordable rates that encourage growers to use available surface water in lieu of pumping groundwater. In normal years, TID allows growers up to 48 inches of “available water” per acre. Much of the surface water applied in TID recharges the groundwater system, supporting groundwater sustainability. Water recharged into the groundwater system for storage can then be pumped in dry years to supplement reduced surface water supplies, supporting crop production even in drought. In TID’s 2025 two-tiered increasing block rate pricing structure, water is less expensive during normal years and more expensive during dry years, encouraging water conservation and generating additional revenue to cover costs associated with the pumping needed to supplement reduced surface water supplies.
- **Reduction of Available Water and Season Length in Dry Years.** As described previously, TID’s Board of Directors determines the annual water availability for growers each year. The “available water” determination is made considering staff recommendations and available data regarding water supplies, runoff and carryover storage projections, availability of rented pumps, and instream flow requirements. During dry years and periods of drought, the amount of water available to the growers is progressively reduced, as needed, to balance available supplies with carryover storage requirements. The irrigation season length was also reduced in 2014 and 2015 to reduce consumption and distribution system losses of drought-limited water supplies.

References

DWR. 2025. A Guidebook to Assist Agricultural Water Suppliers to Prepare a 2025 Agricultural Water Management Plan. California Department of Water Resources. Final September 2025.

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Appendix H
DWR Water Budget Reporting Tables

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This appendix presents the water year water budget tables required by DWR for the 2025 Agricultural Water Management Plan (AWMP).

As described in **Section 5.5**, Turlock Irrigation District (TID) has historically prepared agricultural water budgets on a calendar year basis. Calendar year accounting more directly reflects irrigation seasons, grower practices, and TID operations.

Water year budgets have not historically been reported because the TID irrigation season typically begins in March and may extend into October or November, spanning two water years (October 1–September 30). Water year reporting therefore divides a single irrigation season between reporting periods.

To meet updated AWMP requirements pursuant to AB 1668, TID has prepared a boundary water balance on a water year basis for the TID service area.

The water year water budget tables are provided in Table H-1 (Inflows) and Table H-2 (Outflows). A schematic of the boundary water budget is shown in Figure H-1, illustrating the relationship between TID boundary flows and the DWR-required inflow and outflow components. Because the irrigation season spans two water years in most years, flow components in the water year budgets differ slightly from the calendar year water budgets presented in **Section 5** of the AWMP.

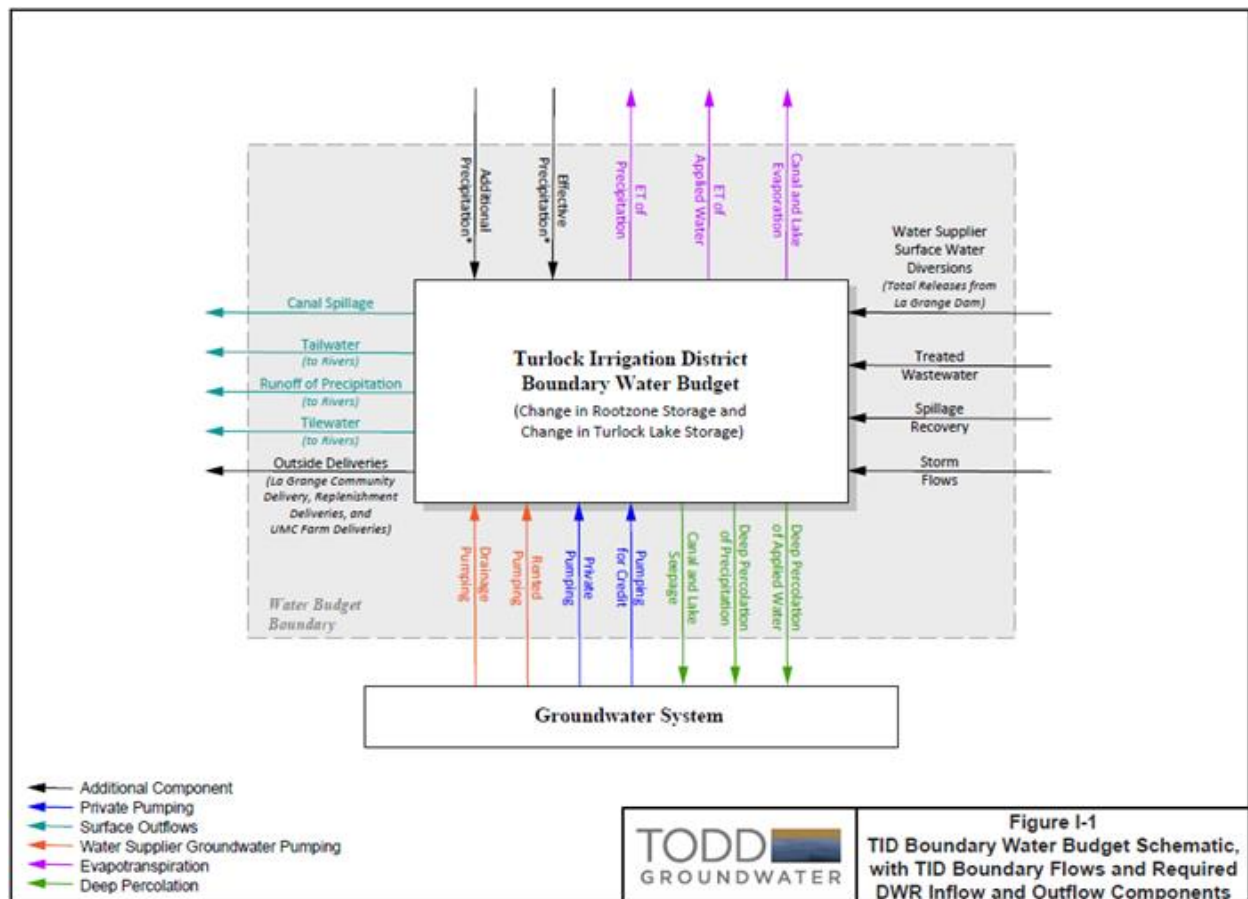


Figure H-1. TID Boundary Water Budget Schematic, with TID Boundary Flows and Required DWR Inflow and Outflow Components.

**Effective precipitation is equal to ET of precipitation, which is accounted as an outflow from the TID water budget. To balance the TID water budget, Effective Precipitation and Additional Precipitation (Total Precipitation minus Effective Precipitation) are both shown in this schematic.*

Table H-1. Water Budget Inflows (DWR Table V-1).

Inflow Components	AWMP Location for Supporting Calculations	Volume Quantification Method ¹	Percent Uncertainty ¹	Uncertainty Quantification Method ¹	Volume (AF/water year)				
					2020	2021	2022	2023	2024
Effective Precipitation. ²	5.3.3.1; 5.3.3.2.2	Modeled	10%	Estimated	62,522	47,994	52,016	105,798	88,046
Water Supplier Surface Water Diversions ³	5.3.1.1	Measured	5%	Measured	504,930	415,954	369,442	626,257	571,572
Water Supplier Groundwater Pumping ⁴	5.3.1.2	Calculated	20%	Estimated	70,195	93,506	76,645	36,166	39,250
Private Pumping ⁵	5.3.1.3	Calculated	20%	Estimated	70,497	103,566	159,686	47,573	40,149
Other - Treated Wastewater ⁶	5.3.1.4	Measured	10%	Estimated	5,209	4,792	4,198	4,281	5,087
Other - Spillage Recovery ⁷	5.3.1.4	Calculated	20%	Estimated	1967	1720	1,304	1,917	2,144
Other - Additional Precipitation (Total Precipitation minus Effective Precipitation) ²	5.3.2; 5.3.3.2.2	Measured	30%	Estimated	37,522	22,518	39,747	106,356	77,696
Other - Storm Flows ⁸	5.3.1.4	Modeled	50%	Estimated	5,498	2,050	3,524	20,092	5,552
Total Inflows					758,340	692,100	706,562	948,440	829,496

¹ For required Inflow Components that include multiple TID water budget flow paths, the quantification methods and uncertainty represent the typical methods and uncertainties among all flow paths represented.

² Effective precipitation is equivalent to ET of Precipitation, which is accounted as an outflow from the TID water budget. To account for all inflows, the additional precipitation (total precipitation minus effective precipitation) has also been added as an “Other” Inflow Component.

³ Total Releases from La Grange Dam (Planned and Irrigation)

⁴ Total Drainage Well Pumping and Rented Well Pumping

⁵ Total Private Pumping and Pump for Credit

⁶ Farm deliveries of treated wastewater

⁷ Recovery of spillage from Harding Drain into Lateral 5.5

⁸ Rainfall runoff from lands upslope of District that flow into TID's distributions system

Table H-2. Water Budget Outflows (DWR Table V-2).

Outflow Components	AWMP Location for Supporting Calculations	Volume Quantification Method ¹	Percent Uncertainty ¹	Uncertainty Quantification Method ¹	Volume (AF/water year)				
					2020	2021	2022	2023	2024
Evapotranspiration ²	5.3.3.1; 5.3.3.2	Modeled	10%	Estimated	448,365	487,080	466,469	442,869	454,582
Surface Outflows ³	5.3.1.4; 5.3.1.5; 5.3.3.1	Measured	9%	Measured	72,464	38,459	34,447	162,344	114,626
Deep Percolation ⁴	5.3.3.1;5.3.4; 5.3.1.5	Calculated	50%	Calculated	265,853	175,972	216,637	334,317	265,127
Other - Outside Deliveries ⁵	2.2.1.1;2.2.3; 3.5; 4.1.2	Calculated	10%	Estimated	1,484	1,431	1,403	5,560	7,600
Other - Change in Storage ⁶	5.3.3.1; 5.3.3.2.2;5.3.4	Calculated	20%	Calculated	-29,827	-10,842	-12,393	3,350	-12,439
Total Outflows					758,340	692,100	706,563	948,440	829,496

¹ For required Outflow Components that include multiple TID water budget flow paths, the quantification methods and uncertainty represent the typical methods and uncertainties among all flow paths represented. Details on each TID water budget flow path are provided in Table I-4.

² Evapotranspiration of applied water , Evapotranspiration of precipitation, Turlock Lake Evaporation, Evaporation from Canals

³ Operational Spillage, Planned Spillage, Tailwater to Rivers, Tilewater to Rivers, and Runoff of Precipitation

⁴ Deep Percolation, Turlock Lake Seepage, Canal Seepage

⁵ Deliveries to La Grange Community, Replenishment Deliveries, and Deliveries to lands off the Upper Main Canal

⁶ Rootzone Change in Storage and Turlock Land Change in Storage