



WASTEWATER TREATMENT PLANT



CITY OF DAVIS WASTEWATER UTILITY 101

PUBLIC WORKS – UTILITIES & OPERATIONS



WASTEWATER TREATMENT PLANT LABORATORY



VAC-CON

UTILITIES COMMISSION

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WHAT IS WASTEWATER?

Wastewater, sometimes referred to as sewage, is water that has been impacted from ordinary living processes, including household, commercial and industrial uses. It is essentially “used” water, containing materials and particles that would negatively impact people and the environment if left untreated. Wastewater entering a treatment plant is also called “influent,” and treated wastewater is called “effluent .”

As with most municipalities in California, the City of Davis collection and storm drain systems are separate. Wastewater flows to the wastewater treatment plant via the collection system and stormwater flows directly to local waterways, untreated.



The City’s **Wastewater Division** operates and maintains the City’s wastewater system, supporting the residential, commercial, and industrial activities of the community. This includes the operation and maintenance of the collection system, treatment plant, and restoration wetlands, as well as the treatment of the wastewater generated in the Yolo County service areas of El Macero, North Davis Meadows, Davis Creek (formerly Royal Oaks) Mobile Home Park, and the Teichert Construction Complex.

The Collection System

The City’s wastewater collection system serves a population of about 66,630 people in Davis’ 10.5 square mile service area. The system serves 15,665 residential connections, and 540 commercial, industrial and institutional customers (as of 2019).

Components of the Collection System:

- 164 miles of gravity sewers (approximately 3,300 line segments) ranging in size from 6 to 66 inches in diameter – to transport the wastewater to the pump stations
- 3,224 manholes
- 6 pump stations
- 2.63 miles of force mains ranging in size from 4 to 14 inches – to transport the wastewater from the pump stations
- Roughly 123 miles of sewer laterals



Did You Know: Approximately 20 percent of the sewer mains are located in easements granted to the City (on private property)

WASTEWATER TREATMENT PLANT



The City's **Wastewater Treatment Plant** (also called the Water Pollution Control Plant), located near the Yolo County Landfill, is owned and operated by the City of Davis. The discharge from the plant is regulated by Order No. R5-2018-0086 under National Pollutant Discharge Elimination System (NPDES) Permit No. CA0079049. The facility is permitted for 7.5 mgd (million gallons per day). The existing treatment system design capacity is 6 mgd based on average dry weather flow. There are two permitted discharge points from the plant. Treated effluent is discharged to the Willow Slough Bypass (Discharge Point No. 001) and the Conaway Ranch Toe Drain (Discharge Point 002).



Treatment Process - The current treatment process consists of:

Screening – using a mechanical bar screen to sift out large material such as rags, wood, or rocks)

Aerated grit removal – particles of sand and/or silt are removed from the wastewater in an aerated chamber where heavier particles sink to the bottom of the tank

PRELIMINARY TREATMENT

Sedimentation – Wastewater velocity slows to a point where heavier material sinks to the bottom of a tank and is removed for additional treatment while the remaining wastewater flows to secondary treatment

PRIMARY TREATMENT

Activated sludge – Naturally occurring bacteria are cultivated in tanks. Wastewater from the primary treatment flows into the tanks and the bacteria consume the organic waste in the water. Oxygen is added to create the ideal environment for the bacteria to thrive. The mixed water then flows to clarifiers to allow the bacteria to sink to the bottom and be recycled back to the aerated tanks while the remaining water flows to tertiary treatment.

SECONDARY TREATMENT

Filtering – Water from the secondary process flows to filters that remove any remaining particulate material.

Disinfection – Water from the filters is injected with a chlorine solution to provide disinfection. After the chlorine has disinfected the water, sodium bisulfite is added to remove the chlorine from the water prior to being sent to the Willow Slough Bypass.

TERTIARY TREATMENT

Wetlands

The Davis Wastewater Treatment Plant treats water at the tertiary level, the final cleaning process that produces high quality treated wastewater. This is reused in the wetlands to support habitat, benefitting wildlife and humans alike. The wetlands also provide drainage for stormwater during the rainy months. The City is looking at long-term objectives for the wetlands now that tertiary treated water is available due to the changes in the wastewater treatment process with the recent upgrade.



NECESSARY PLANT UPGRADES

Wastewater Treatment Plant Upgrades - pre 2013



The plant was built in 1970, and updated new treatment processes in 1995. The plant was updated again in 1998 with the addition of the wetlands for permit compliance.

Wastewater Treatment Plant Upgrade (2013-2018)

From 2013-2018, the City of Davis' Wastewater Treatment Plant was upgraded in order to meet State and Federal regulatory discharge requirements. The upgrade was accomplished in two phases: the Rehabilitation and Replacement (R&R) Phase and the Secondary and Tertiary Improvements (STI) Phase. The planning for upgrading local wastewater facilities began in 2001 when the Central Valley Regional Water Quality Control Board initiated new water discharge limits.

The new upgraded facility has allowed the city to move wastewater treatment from a land-based system, with an average treatment time of 40 days, to an activated sludge system with an average treatment time of 23 hours. This change has also significantly improved effluent quality. The new system can treat an average of 6 million gallons a day. The improvements also included a berm built to surround the plant and protection from flood waters.

The upgraded Wastewater Treatment Plant has also earned the Envision Silver Award for sustainable infrastructure from the Institute for Sustainable Infrastructure.



OPERATIONS AND MAINTENANCE

Mission

The mission of the City's Wastewater Division is to operate and maintain the City's sanitary sewer system in accordance with federal, state, and local regulations to protect public health and ensure the safe, efficient, reliable, economical, and environmentally sound collection, treatment, and disposal of the City's wastewater in order to support the residential, commercial, and industrial activities of the community.



The Wastewater Division is housed in the Public Works – Utilities & Operations Department and has one division manager. The division employees represent two areas of focus within Wastewater:

- **Collections Team (6 team members)**
- **Wastewater Treatment Plant Team (13 team members)**
 - **Maintenance (5)**
 - **Operations (5)**
 - **Laboratory (3)**

Two utility and Supervisory Control and Data Acquisition (SCADA) controls system technicians, an electrician, a water quality coordinator (focused on wastewater regulatory compliance) and an environmental program specialist (focused on source control) also assist the division. In addition, the city's Wildlife Resource Specialist works with the team on the Wetlands habitat areas.



OPERATIONS AND MAINTENANCE

Collections Crew

The Collections Crew performs preventative maintenance on the city's sanitary sewer system including:

- Cleaning of sewer pipe and maintenance holes
- Weekly, monthly and quarterly sewer lift station inspections and cleaning, including maintenance of valves or pumps
- Closed circuit television (CCTV) inspection
- Inspection of gravity sewer pipe and maintenance holes
- Force main inspections
- Root cutting and chemical treatment of service laterals
- Regular wash downs of the sewer lift station wet wells

Performs reactive maintenance including:

- Repairs of sewer segments, maintenance holes, service laterals, clean outs and sewer service connections
- Response to all sewer emergency calls and environmental cleanup activities
- Assists in the removal and repair of sewer lift station pumps and associated parts
- Removal of material from clogged lift station pumps

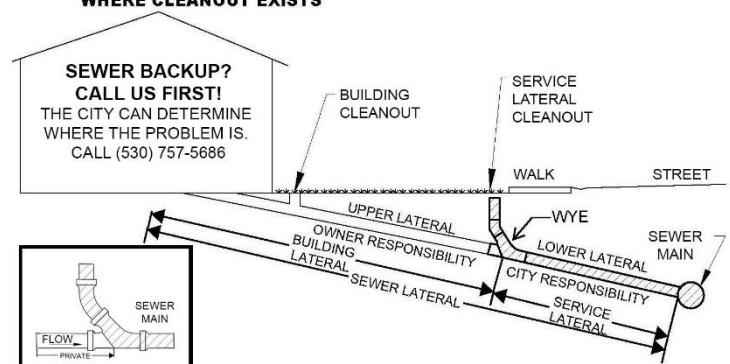


Customer Concerns:

The Collections Crew also performs maintenance responsibility checks for sewer laterals.

FRONT YARD SEWER LATERAL

MAINTENANCE RESPONSIBILITIES FOR UPPER AND LOWER LATERAL WHERE CLEANOUT EXISTS



The Collections Crew responds to sewage system overflows (SSOs) on public and private property. The crew works to prevent system overflows or leaks that could enter the storm drain system or waterways.

Lastly, the Collections Crew participates in the Public Works Utilities and Operations standby program to respond to after-hours customer concerns.

OPERATIONS AND MAINTENANCE



Wastewater Treatment Plant Crew

The Wastewater Treatment Plant Crew complies with the final discharge requirements of the NPDES permit which is accomplished by operational, maintenance, electrical, and instrumentation tasks.

Operations

- Provide 24 hour, 7 days per week service to operate the treatment plant and monitor the City's sewer lift stations
- Execute operational controls and monitoring of plant processes
- Interpret laboratory test results of the treatment process and make process control changes as needed
- Perform corrective and repair work on plant systems
- Initiate emergency response for treatment facility equipment failures

Electrical

- Troubleshoot, maintain, and replace high, medium, and low voltage electrical components in the treatment plant, sewer lift stations, wetland pump stations, and stormwater pump stations

SCADA (Supervisory Control and Data Acquisition)

- Perform comprehensive preventative and corrective maintenance on electrical, electronic, pneumatic, and mechanical equipment utilized in the treatment plant and pump station control systems
- Maintain and calibrate process analysis and controls equipment
- Set and monitor alarm functions
- Troubleshoot and modify the facility's SCADA system which communicates and controls all remotely controlled process equipment



Maintenance

- Conduct a comprehensive preventative and corrective maintenance program on all mechanical equipment related to the treatment plant, wetlands and sewer lift stations
- Perform integrated pest management at the treatment plant and wetlands
- Perform grounds and building maintenance
- Operation of heavy equipment such as trucks, tractors, and backhoes in support of wastewater operations and maintenance activities

Laboratory

- Perform chemical, biological, and bacteriological analysis of drinking water, wastewater, biosolids, and industrial waste
- Maintain laboratory Quality Assurance and Quality Control (QA/QC) programs
- Continuous evaluation and updating of sampling and testing methods
- Arrange for outside testing needs
- Maintain appropriate certifications with Environmental Laboratory Accreditation program
- Prepare all required regulatory monthly, quarterly, and annual monitoring reports



SOURCE CONTROL

Pretreatment Programs

The City's Pretreatment Program was established in 1995 as required by the US Environmental Protection Agency. The term **pretreatment** refers to the reduction of pollutants, the elimination of pollutants, or the alteration of the nature of pollutant properties, in wastewater prior to discharging or introducing such pollutants into a treatment plant.

Pretreatment programs provide outreach, education, and enforcement of the City's ordinances and permit requirements, related to the residential, commercial and industrial sources of wastewater, and identifying issues or concerns at the site of discharge. The goals of the program, in accordance with the Federal Clean Water Act, include:

- To prevent interference with treatment plant operations
- To protect public health and safety
- To protect the structure and integrity of the wastewater collection system to ensure that personnel working in the system are safe
- To protect the environment by preventing toxic or hazardous substances from passing through the treatment plant to the receiving water
- To improve opportunities to recycle and reclaim municipal and industrial wastewaters and sludges

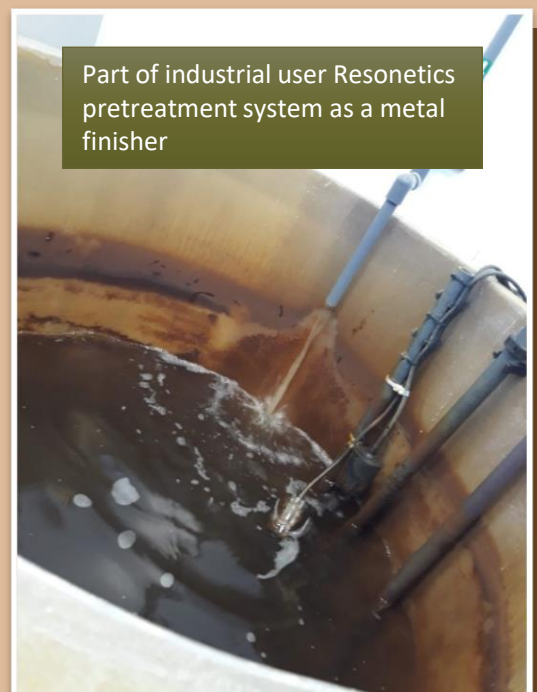


Industrial Pretreatment Program

The Industrial Pretreatment Program regulates discharges from Significant Industrial Users (SIU) which are industries that discharge at least 25,000 gallons of wastewater per day. SIUs have a reasonable potential to interfere with treatment plant operations, to cause pass-through and/or sludge contamination.

The City has three significant users under this definition, the California Brewing Company, Frontier Fertilizer, and the Yolo County Landfill.

Industrial users are inspected either annually or semi-annually, with sampling completed by the city to verify discharge limits are being met. Most facilities keep in regular contact with Pretreatment staff and there are often informal inspections or site visits.



Part of industrial user Resonetics pretreatment system as a metal finisher



SOURCE CONTROL

Pollution Prevention Programs

The Pollution Prevention Program focuses on residential, commercial, and industrial discharges not regulated under the Industrial Pretreatment Program. Pollution prevention includes education and enforcement to prevent conditions that lead to sanitary sewer overflows.

One of the focuses of the Pollution Prevention Program is on the proper disposal of fats, oils, and grease (FOG). FOG can solidify and build-up on the walls of sewer pipes leading to clogged sewer lines and expensive plumbing maintenance for property owners and the city.



This program includes inspections of food service establishments at least annually. If an establishment cooks any food as part of its business, it is required to install a grease trap or interceptor (Grease Removal Device – GRD). Inspection includes sampling the interceptor or checking levels in the traps. Inspection of vent hoods and regular cleaning maintenance is also conducted at this time. Some establishments with limited cooking or preparation can be considered exempt from this requirement but an application requesting exemption is required to be approved by the Public Works Utilities and Operations Department. The exempt businesses are inspected to ensure they are still utilizing BMPs (Best Management Practices) when it comes to disposing of waste down the drain and proper solid waste separation handling.

Residential Outreach and Education

The City also provides information on what can/cannot be disposed of down the drain and down the toilet in order to keep sewer lines clear.

Recent residential outreach has been focused on flushable wipes and how the wipes do not break down in the sewer system which can lead to clogs in the sewer lines. Another outreach focus was reminding residents to remove the plastic labels from fruits and vegetables.

Wastewater treatment facilities are not equipped to deal with sticky, small pieces of plastic, like the plastic labels on fruits and vegetables, when rinsed down the drain. The labels can clog filters and end up in our waterways.



KEEP THE PIPES FLOWING



NO FATS, OILS OR GREASE DOWN THE DRAIN
Fats, oils and grease build up on the walls of sewer pipes and can cause sewage backups. Small amounts of cool, hardened FOG can go in your organics cart. Larger amounts should go in a container and be placed in the trash or taken to the free hazardous waste drop-off for recycling.



KEEP HAIR OUT OF DRAINS
Hair can cause clogged drains and is very difficult to get out of the pipes once it gets in. Consider using a drain screen to keep hair from going into the pipes and dispose of hair in the organics cart (yes, hair is compostable!).



KEEP FOOD WASTE OUT OF THE SINK
The best place for food scraps is in the organics cart for composting, not in the sink. If you do place fruit or vegetable peels in the garbage disposal, remove the plastic label first.



DON'T FLUSH GARBAGE
Only human waste and toilet paper should be flushed down the toilet. "Flushable" or "Disposable" products such as wipes, diapers or feminine products belong in the trash.



WASTEWATER QUALITY

Wastewater Quality Regulations

Wastewater quality is regulated through the City's NPDES permit, which includes monitoring and reporting requirements for the City under the authority of the Central Valley Regional Water Quality Control Board (CVRWQCB).

In addition to routine monitoring and reporting required by the City's NPDES permit, technical reports and special studies are also required. Monitoring of required parameters from various locations at the plant is to ensure that treatment processes under normal operating conditions meet wastewater quality objectives in order to comply with the effluent limits (i.e. treated water quality), for the protection of aquatic life and the environment at both discharge locations.

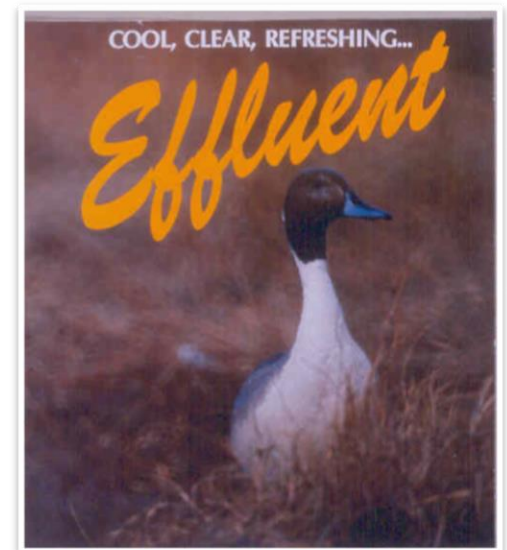


Did You Know: the Wastewater Treatment Plant effluent limits are more stringent than the drinking water constituents for maximum contaminant levels.

Technical Reports and Additional Monitoring Requirements

The following technical report examples illustrate the required reporting the City is responsible for (above and beyond regular testing), based on results of routine monitoring of treated effluent, or as required by the NPDES permit:

- Toxicity Reduction Evaluation Work Plan
- Studies of Dissolved Metals in Willow Slough Bypass to ensure Wastewater Plant effluent limits are protective of the environment
- Best Management Practices Plans and Pollution Prevention Plans:
 - Pollution Prevention Plan for Mercury
 - Salinity Evaluation and Minimization Plan



Special Studies

Special studies are required by the Regional Water Board throughout the Central Valley Region or across multiple dischargers, and can be conducted individually or through collaboration with other agencies. Collaborative studies are typically conducted regionally through the Central Valley Clean Water Association, or through the Regional Water Board. The cost of a special study through collaboration is shared amongst participating agencies, leading to a cost-savings for the municipalities involved. In addition to the financial contribution, the City also provides technical expertise and staff time.

There are several special studies that the City is required to conduct on its own, based on the particular characteristics of the City Plant and treated effluent. For site-specific studies, the City bears all the costs and the requirement is for the City only.



WASTEWATER QUALITY CONTROL

Laboratory Support for the City

The Wastewater Treatment Plant facility includes a State certified in-house laboratory, that conducts basic chemical, biological and microbiological testing for both process and permit compliance monitoring purposes. The laboratory staff assists with sample collection, field testing, data review and reporting. They also support the drinking water, pretreatment, and stormwater divisions within the City by assisting with sample collection, data review and reporting needs. The lab staff receives assistance from plant operators for sample collection and field testing.



The in-house laboratory is not a full-service lab, however, the analytical testing of other parameters required by the NPDES permit is conducted by commercial laboratories under contract agreement with the City. The lab manages all of the contract lab work and project management.

Compliance Testing

In-house analyses

- pH
- Electrical Conductivity
- Dissolved Oxygen
- Biochemical Oxygen Demand
- Total Suspended Solids
- Total Dissolved Solids
- Hardness
- Total Coliform / Fecal Coliform

Process Monitoring Testing

In-house analyses

- Chemical Oxygen Demand
- Volatile Suspended Solids
- Total Solids / Volatile Solids
- Alkalinity
- Nitrate as Nitrogen
- Ammonia as Nitrogen



Samples Collected for NPDES Requirements and Process Monitoring

	Analyzed In-House	Analyzed by Contract Lab	Total	Total # of Samples Per Year
Daily - Process	35	0	35	12,775
Weekly - NPDES	20	12	32	1664
Weekly - Process	93	0	74	5252
Monthly - NPDES	1	2	3	36
Monthly - Process	0	7	7	84
Quarterly - NPDES	0	6	6	24
Semi-Annual NPES	28	8	36	72
Annually - NPDES	0	180	180	180
Totals	177	223	400	20,087



WASTEWATER RATES

Current Rate Structure

The City’s current rate structure is a variable/fixed rate structure based on average winter water consumption, the type of business operations or the number of dwelling units on the property. Winter water use averages offer a more realistic estimate of volume of water being discharged into the sewer system (given the high irrigation use during the rest of the year in our area.)

Wastewater Utility Billing

Wastewater rate billing is based on customer class and parcel type, and includes:

- A fixed monthly base rate
- A fixed per unit rate
- A variable rate, based on water consumption

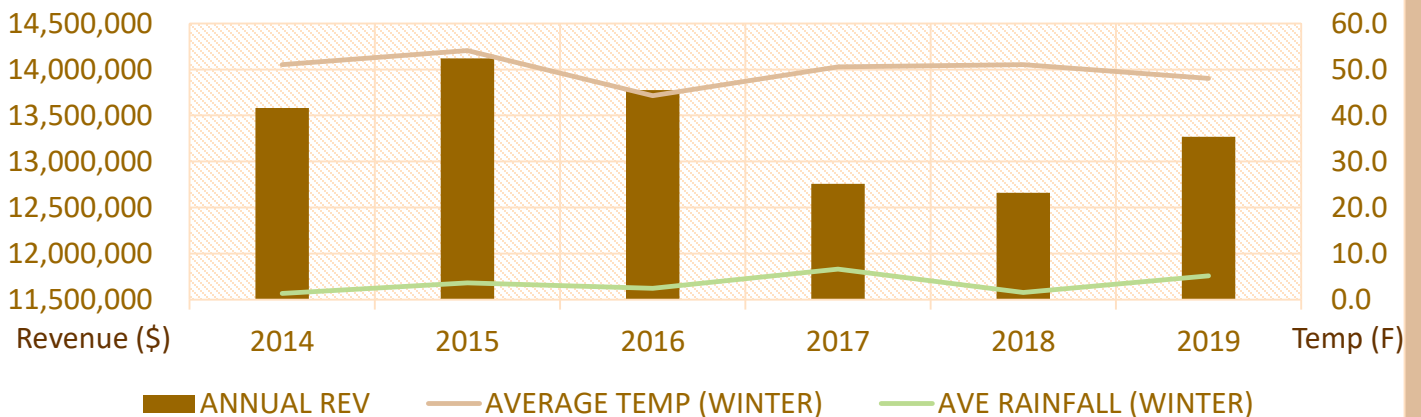
The calculation of the rates are based on the average water consumption over the four months of November, December, January and February. This four-month average is a calculation strongly supported by environmental groups, as the rates encourage water conservation.

Customer class charges were reallocated in 2017, to ensure that each customer class would be charged the appropriate amount for the cost of treating the material going down the drain.

Weather and Wastewater Rates

Since a portion of the wastewater rates (or sewer rates as they are called on the bill) for Davis customers are volumetric, the amount of revenue received by the City is subject to many factors, including the average temperatures in winter, the amount of rainfall, and water conservation measures. The chart below illustrates the fluctuations in revenue as compared with winter temperature averages and rainfall. The warmer the weather, the more water is used during the months that make up the sewer rate calculations.

Winter Water Use: 2014-2019



BUILDING A RESILIENT UTILITY

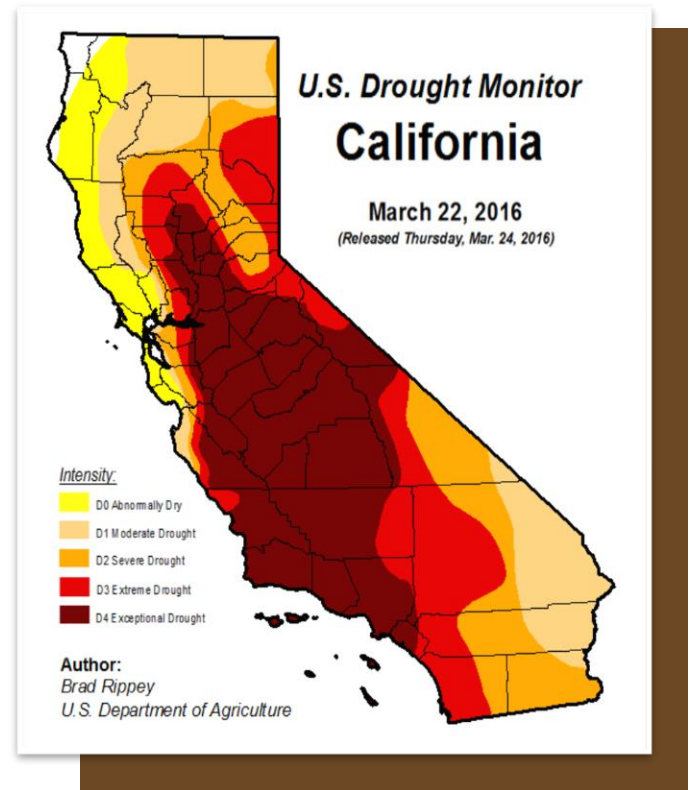


Less Water Use and Wastewater Treatment: Unintended Consequences

Water efficient devices and reductions in water flows (from drought or other prolonged instances of decreased water use) have been causing concern, and in some cases, environmental impacts within municipal wastewater systems. To reliably remove pollutants from water flow in the sewer system, wastewater operators assume a predictable flow from its customer base. Systems have been built based on anticipated water use – the sizing of sewer pipes in most areas of Davis, for example, assume larger flows than are currently received. Reducing the flow of water to the sewer can damage infrastructure (waste materials within the system can contribute to the deterioration of the pipes if not moved properly).

In some cases, the density of the flow, due to less water, may be impacting the treatment process and throwing off the bacteriological balance which can make treatment more difficult and/or costly.

Water use in California can be unpredictable, however, it is clear that the State is looking to require cities to reduce water use in the coming years through water use efficiency measures and with shifts to alternative water sources. The impacts of these reduced water flows into the sewer system, (or the alternative water sources on treated water quality), are still being studied. The City of Davis uses a BioWin simulator to model treatment processes and to test impacts of environmental changes, like drought.



Balancing Multiple Objectives

Improvements in the quality of the discharged water, and declining potable water use across the state, have pushed the discussions around the use of recycled water to the forefront of efforts to build resilient communities. While treated water is typically discharged into watersheds or wetlands, the demand for “recycled water” (this treated water) is increasing. This can lead to some difficult discussions on priority use. Rivers and streams with reduced water flow can greatly benefit from treated water (to maintain delicate ecosystems), however, other downstream users may have alternative objectives, such as irrigation for public landscaping or farms, industrial uses, or groundwater recharging.

BUILDING A RESILIENT UTILITY



Public Works Utilities and Operations staff is in the process of developing comprehensive plans for responses to climate-related changes and impacts on wastewater infrastructure.

Recycled Water

With the most recent Wastewater Treatment Plant upgrade, the tertiary treated and disinfected effluent can be used as recycled water at the plant, and the nearby Yolo County Central Landfill. A permit is required to use recycled water, the City has submitted a notice of intent (NOI) for the use of recycled water at the plant and the landfill. A consultant has been assisting the City with a design for a pump station to supply recycled water for approved uses.

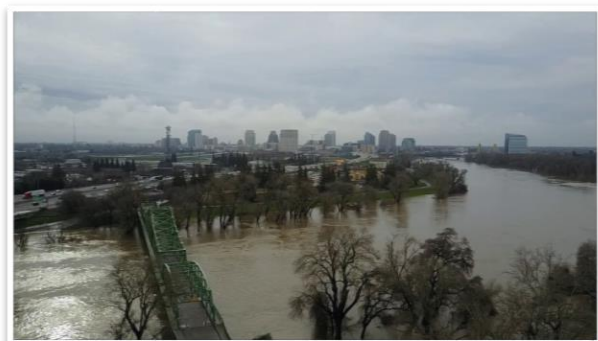
In conjunction with this effort, the City has initiated water rights discussions with legal counsel in order to preserve its rights should agreements for recycled water use with downstream users become a reality.



Timely and Necessary Plant Upgrades

With wastewater utilities, flexibility, adaptability and resiliency are essential tools of the trade. Unlike infrastructure systems moving only water (such as water and stormwater utility systems), wastewater pipes move water, large solids and grit (among other things) which can disrupt the treatment process, cause extensive wear and tear on equipment, and often results in the need for equipment replacement sooner than water and stormwater counterparts. In addition, regulatory changes place an added need for flexibility and adaptability within wastewater systems, to comply with increasingly stringent requirements for treated effluent. These factors often contribute to an ever-changing wastewater system, with more frequent and necessary improvement projects. Once an upgrade ends, equipment replacement often begins, requiring a different type of management than focused on water or stormwater sewer systems.

The response to climate on wastewater collection and treatment systems is also a focus of these consistent upgrades. In addition to plans in response to increasing drought periods in California, and the associated impacts on wastewater collection systems within the Central Valley Region, wastewater operators must also prepare for flooding events (such as those experienced in 2017), and fire impacts to infrastructure (like the Camp fire).





BUILDING A RESILIENT UTILITY

Sanitary Sewer Management Plan

Upcoming regulation changes within the Sanitary Sewer Management Plan (SSMP), required by the State, are coming in regards to identifying climate change impacts to utilities. Plans also must address current weather-related events. Recent wildfire events have demonstrated the risk to utility operations, such as with the Camp fire, when the fire destroyed two of the lift stations in Paradise, causing significant sanitation issues.

This Plan includes an Overflow Emergency Response Plan, in place to ensure that there are procedures to clean-up sanitary sewer overflows as soon as possible, to minimize health hazards to the public and to protect the environment, and includes a System Evaluation and Capacity Assurance Plan, that uses modeling to ensure that the Davis collection system is adequate for demand. The plan also includes short-term and long-term projects to review and enhance collection system capacity as necessary.

Pipe Repair and Replacement Program

Staff regularly inspect and assess the city's collection system. This allows the city's Public Works Engineering and Transportation Department to develop a comprehensive pipe repair and replacement program (as required by the SSMP). Repairing and replacing pipes proactively could help to prevent SSOs and other failures that damage infrastructure and pose potential health risks to people or harm to the environment.

The City recently completed a sewer truck line rehabilitation program, where the trunk sewer system lines were sealed to protect the pipes from infiltration of water in flood events.

Emergency Response

The recent upgrade of the plant included elements to protect the plant in emergency situations. A berm was constructed around the plant to protect the facility from flood waters, the plant is built to handle high capacity water events, and backup generators are located at plant and lift stations to provide between 24 to 48 hours of operation after power loss in the event of a significant power outage. The Wastewater Division also has a portable 6" pump that can act as a lift station (operating off of a suitable support system in the field) to run wastewater to manholes in the event of lift station failure.

Public Works - Utilities & Operations

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