SOLANO COUNTY GRAND JURY

2018-2019

WASTEWATER TREATMENT PLANTS

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I. SUMMARY

Drought has made water a hot topic. The Solano County Grand Jury (Grand Jury) discovered that millions of dollars are spent to build and operate wastewater treatment facilities, with the treated wastewater (effluent) discharged into streams, marshes and rivers, or into settling basins/ponds to evaporate or seep into the ground.

The Grand Jury researched the history of wastewater regulations and investigated four treatment plants to see the uses of effluent. If effluent could substitute for water to irrigate crops, that usage would dramatically decrease Solano County's growing need for water. As the population of Solano County increases, such an undertaking would contribute significantly to the water supply. While costs may be prohibitive, such a change might be desirable under extreme drought conditions.

II. INTRODUCTION

Each wastewater treatment plant operates under its own discharge permit, each using a specific method. Some plants discharge effluent into the Sacramento River, others to a marsh, while others to a percolation pond.

III. METHODOLOGY

Toured:

- Benicia Wastewater Treatment Plant; interviewed staff
- Dixon Wastewater Treatment Facility; interviewed staff
- Fairfield-Suisun Sewer District Wastewater Treatment Plant; interviewed staff
- Vacaville Easterly Wastewater Treatment Plant; interviewed staff

Reviewed:

- The United States Environmental Protection Agency documents relevant to wastewater treatment
- Federal Water Pollution Control Act also known as the Clean Water Act (1972) 33 U.S.C. 1251, et seq.
- National Oceanic and Atmospheric Administration, United States Department of Commerce report
- United States Department of Agriculture 2012 Census of Agriculture for Solano County
- Fairfield-Suisun Sewer District brochure – online at: https://www.fssd.com/wp-content/uploads/2015/08/District-Brochure-_Publisher_ed.5.pdf
- Encyclopedia Britannica – Methane - online at: https://www.britannica.com/science/methane
- California Department of Transportation: Long-Term Socio-Economic Forecasts by County

- Dixon Pipeline, online publication at: https://www.dixon.ca.us/DocumentCenter/View/6963/Dixon-Pipeline-Winter-15-Final?bidld=
- California Code of Regulations, Title 23. Waters, Division 3. State Water Resources Control Board and Regional Water Quality Control Boards, Chapter 26. Wastewater Treatment Plant Classification, Operator Certification, and Contract Operator Registration, Article 2. Classification of Wastewater Treatment Plants, Owner Reporting Requirements, and Criteria for a Class I Wastewater Treatment Plant, § 3676. Reporting Requirements for Owners of Wastewater Treatment Plants (Also identified as "23 CCR § 3676")

IV. STATEMENT OF FACTS

Millions of dollars are spent to build and operate wastewater treatment facilities, only to see the effluent discharged into streams, marshes, rivers or settling basins to evaporate or seep into the ground. For some cities this may be the best way of handling the effluent short of spending additional funds. Additional spending would create financial burdens to the taxpayers.

A. GROWTH IN SOLANO COUNTY

In 2017, Solano County was home to 437,000 residents, living in 149,000 households. By 2037, CalTRANS anticipates a population of over 500,000 residents and 174,000 households. A 2014 residential water use study noted that Solano County residents use approximately 69 to 98 gallons per capita per day. Using a nominal 80 gallons per capita per day and 63,000 new residents, Solano County will need an additional 1,600,000 gallons of potable water per year by 2037. Drinking water, also known as potable water, is water that has complied with State regulations and is safe to drink or to use for food preparation.

Drought has made water a topic for discussion in our newspapers, television and state legislature. The Grand Jury noted that millions of dollars are spent to build and operate wastewater treatment facilities, only to see the effluent discharged into a river or a settling basin to evaporate or seep into the ground.

Population growth will lead to an increased demand for water. The Grand Jury examined various possible alternatives to look for potential additional sources of water in Solano County. One such potential source was the effluent from the wastewater treatment plants in Solano County. The Grand Jury investigated four Solano County Wastewater Treatment Plants: Benicia, Dixon, Fairfield-Suisun and Vacaville.

B. WATER USE IN SOLANO COUNTY

According to the United States Department of Agriculture (USDA) 2012 Census of Agriculture for Solano County, there were 860 farms in Solano County, with an average size of 473 acres. 41.7% of that was cropland while the rest was pastureland (54.2%) and other uses (4.1%). The top three crops for Solano County are walnuts, nursery products and almonds. Others in the "Top Ten" were forage-land used for hay, wheat, vegetables and tomatoes. The United States Geological Survey in 2015 estimated that 63.5 million acres were irrigated. The national average application of water usage rate for 2015 was 2.09 acre-feet per acre. One acre-foot is enough water to cover an acre with water one foot deep and equals 325,851 gallons.

An approximation for the above calculations would be the Solano Irrigation District (SID), providing water service to more than 2,530 customers, including 1,330 agricultural customers and 1,200 municipal and industrial (M&I) customers. SID water supply comes primarily from Lake Berryessa through the Solano Project. In the Solano Project water year ending February 28, 2018 (Solano Project water years run from March 1 through the last day of February), approximately 93% of the water was sold for agricultural purposes and 7% to M&I customers. The average annual deliveries from the Solano Project are approximately 200,000 acre-feet, of which the District receives approximately 141,000 acre-feet. 93% of the deliveries were used for agricultural activities, amounting to 128,000 acre-feet.

If one quarter of Solano County's farmland was irrigated at the national average, the irrigation water required would be approximately 150,000 acre-feet per year. The total inflow to the four wastewater treatment plants is approximately 23 million gallons per day or 26,000 acre-feet per year. This wastewater could be used to supplement water used for irrigation, partially relieving Solano County's need for water.

C. WASTEWATER RULES

The Federal Water Pollution Control or the Clean Water Act (CWA) of 1972 establishes the basic structure for regulating discharge of pollutants into the waters of the United States and at the same time regulating quality standards for surface waters. The CWA, which was enacted in 1948 and called the Federal Water Pollution Control Act, was significantly reorganized and expanded in 1972. "Clean Water Act" became the Act's common name with the amendments in 1972.

Under the CWA, the United States Environmental Protection Agency (EPA) implemented pollution-control programs such as setting wastewater standards for industry. Without a permit it is unlawful to discharge any pollutant from a point source into navigable waters. EPA's National Pollutant Discharge Elimination System (NPDES) permit program controls the water discharged into our streams, rivers and waterways. Point sources are discrete conveyances such as pipes or man-made ditches. An NPDES permit is not required for individual homes connected to a municipal system, use a septic system, or do not have a surface discharge. Industrial, municipal and other facilities must obtain permits if their discharge goes directly to surface waters.

The treatment of wastewater, the non-biologic solid waste and the liquid waste varies widely in the county. Wastewater or sewage falls under Title 23 of California Code of Regulations §3676, requiring wastewater treatment plants to operate under a state license.

D. THE BASICS OF WASTEWATER TREATMENT

A mechanical separator is the first piece of equipment that the sewage encounters as it enters the wastewater treatment plant. It removes material such as rags, diapers and other non-biological materials that enter the sewer system. This material is removed, washed and then sent to a sanitary landfill. Next, the speed of the influent (wastewater that enters the plant) is slowed to allow grit (such as sand, coffee grounds and eggshells) to settle. Grit removal protects the downstream plant.

What follows is a four-stage process:

1. The first stage uses anaerobic bacteria to digest what it can.
2. Aerobic bacteria then digest more of the dissolved material. This requires the presence of oxygen, so at this point the waste stream is aerated.
3. At the third stage, clarifiers again slow down the speed of the water to allow further settling of solids.
4. The final stage in the treatment is to kill disease-causing bacteria (pathogens). This can be done with chemicals or ultraviolet light. The wastewater is now fit to discharge into the environment.

E. THE COST OF TREATING WASTEWATER

The treatment of wastewater can be expensive in both the infrastructure and operations. It requires large processing equipment, piping, pumps, chemicals and bacteria to digest organic waste. A place to dispose of processed solid waste is also necessary. The capital costs of constructing sewage treatment facilities is unique to each community. Facilities must be sized to accommodate wide ranges of influent and expected growth.

F. CAPITAL COST EXAMPLES

One example of capital costs can be seen by the facilities serving the community of Dixon. According to the Dixon Pipeline, on July 9, 2015, the City of Dixon celebrated the groundbreaking of its Wastewater Treatment Facility Construction Project. Dixon's old wastewater treatment facility was outdated, unsafe and not able to meet permit requirements set by the Regional Water Quality Control Board.

The $28 million project provides safe, reliable service to Dixon residents and businesses. The project included the construction of two 100-foot diameter final clarifiers, preliminary treatment building, two oxidation ditches, biosolids control building, administration building and demolition of selected existing structures. This construction, at a cost of approximately $1,500 per person, serves a community of approximately 18,000 people.

Another example is the modifications required to address changing regulatory requirements for Vacaville's Easterly Wastewater Treatment Plant (EWWTP). This project included approximately $135 million for the renovation and expansion of the South Plant, denitrification improvements, filtration and other elements that were part of the mandated Tertiary Project to meet the requirements of the NPDES permit, and costs associated with abandonment of the old North Plant. This cost approximately $1,300 per person.

WASTEWATER STATISTICS

	Cost per 100,000 Gallons
Benicia	$1,202
Dixon	$193
Fairfield-Suisun	$345
Vacaville	$1,289

1. City of Dixon

Dixon is one of seven cities in Solano County and encompasses approximately 7.1 square miles. It owns, operates and maintains a municipal wastewater treatment facility (WWTF) including a collection system. The wastewater collection system consists of approximately 72 miles of sewer pipelines within the incorporated and unincorporated area of Dixon including two lift stations.

The main wastewater treatment process includes an open pond system, ranging from 6 to 13 acres each, a headworks, pumps, grinders and screens. The treatment plant has a 160-acre percolation/evaporation pond system for the final effluent discharge. Dixon does not treat with chemicals or ultraviolet light but discharges to a percolation basin.

Dixon built the Wastewater Facultative Pond treatment facility in 1951 with periodic expansions and upgrades. In Spring 2017, the City completed a $28.5 million facility upgrade to an activated sludge-processing treatment. Dixon owns 120 acres of land for wastewater discharge that is not currently used.

The WWTF receives about 1.2 million gallons per day (MGD) of influent during dry weather and about 3.0 MGD during wet weather. Influent goes through multiple steps of treatment starting at the headworks. Mechanical bar screens trap and remove large materials such as rags, diapers and other items that pass through the drains. Everything raked off the screens goes through a washing machine and then a compactor. Next the flow is measured. After that, sand sediment called grit settles in grit basins. Everything taken out by the bar screens and the grit basins goes to landfill.

At present it costs the City $193 to treat 100,000 gallons of sewage. The cost of electricity for running the WWTF was approximately $190,000 for the 12-month period of 2017–2018. The WWTF does not use any chemicals (chlorine, polymers, coagulants, hydroxides or reducing agents). Biosolids will not be removed from the property for three to five more years, therefore there is no cost for removing biosolids.

Treatment is limited to:

1. Primary treatment to remove solid material.
2. Secondary treatment to digest dissolved and suspended organic material.
3. Sedimentation in clarifiers to allow solids that are heavier than water to accumulate at the bottom of the quiescent settling basins. Dixon's clarifiers have skimmers to simultaneously remove floating grease.
4. Effluent is discharged into ponds that allow the water to percolate back into the ground water supply (80% of the effluent) or evaporate.

2. **CITY OF VACAVILLE**

Vacaville discharges treated water to Old Alamo Creek. The Vacaville EWWTP is near new residential construction. The piping systems to return treated effluent to locations in these subdivisions (purple pipe) are being included in some of the construction. This beneficial use for irrigating will offset the need for potable water while enabling the neighborhoods to have green public areas.

Wastewater Operations is responsible for the operation and oversight of the EWWTP. The plant operates 24/7, treats an average of 7.5 MGD of wastewater and has a dry weather treatment capacity of 15 MGD. The plant operates under a National Pollutant Discharge Elimination System permit and is regulated by the Central Valley Regional Water Quality Control Board to provide tertiary level treatment.

Vacaville's EWWTP serves Vacaville, the community of Elmira, the California Medical Facility and most of the Vaca Valley Industrial Park. The EWWTP is a state-of-the-art facility that utilizes many complex processes to produce treated wastewater. Wastewater undergoes primary, secondary and tertiary treatment and disinfection before being released into Old Alamo Creek, where it travels to Cache Slough, and eventually out to the Sacramento River.

Wastewater entering the treatment plant (influent) is about 99% water and 1% solids. Wastewater flows through a typical series of treatment processes.

The purchase of electrical power is augmented by solar power and cogeneration.

The Utilities Department is currently working on a Recycled Water Master Plan. The plan could open the opportunity to further increase the region's irrigation and industrial water supply with a sustainable and reliable alternative to potable water.

3. FAIRFIELD-SUISUN SEWER DISTRICT

Fairfield-Suisun Wastewater Treatment Plant (FSWWTP) discharges its effluent to Suisun Marsh, to irrigate a sod farm and to a private corporation that accepts biosolids.

FSWWTP's effluent receives the highest level of treatment short of providing potable water of the four plants studied. The FSWWTP receives an average daily flow of 12.2 MGD of wastewater. The operation of the FSWWTP is similar to other wastewater treatment facilities. One key difference for FSWWTP is the use of ultraviolet light for disinfection. Other wastewater treatment plants use chlorine to kill pathogens. After final treatment, the effluent is discharged into the Suisun Marsh. FSWWTP also uses innovative on-site methods to generate electricity for its treatment process.

The following steps A through E are common to most plants; however, F through H are unique to FSWWTP.

A. **Preliminary Treatment**: Bar screens and gritting equipment remove debris and grit that are harmful to downstream equipment. Influent flow is measured and recorded at this location.
B. **Primary Treatment**: The primary clarifiers at the head of the facility remove heavier solids through settling.
C. **Intermediate Treatment**: The oxidation towers and intermediary clarifiers remove soluble organic matters.
D. **Secondary Treatment**: Secondary treatment is accomplished in the aeration tanks and secondary clarifiers. Bacteria consume organic matter in the intermediate treatment effluent, generating an activated sludge. To survive, aerobic bacteria need oxygen that is provided in the aeration tanks. Secondary clarifiers remove the activated sludge through settling.
E. **Tertiary Treatment**: Filters provide a polishing step to remove the few suspended particles remaining in the secondary clarifier effluent.
F. **Ultraviolet (UV) Disinfection**: UV light destroys the genetic makeup of pathogenic organisms to prevent the spread of waterborne diseases to downstream users and the environment.
G. **Final Effluent Storage**: Final effluent can be discharged directly into the Suisun Marsh, or temporarily stored in large, earthen reservoirs for later use in irrigation or utility applications.
H. **Anaerobic Digestion**: Solids removed in the clarifiers are thickened and then digested in a closed vessel. Digesters provide an environment to reduce the organic matter and disease-causing organisms.

Methane is a colorless odorless flammable gas. It occurs naturally when organic matter is decomposed by anaerobic bacteria in environments such as lake bottoms and wastewater treatment facilities. At FSWWTP, methane is produced as the solids are digested and is used as a fuel for on-site electrical generators. This is in addition to the on-site wind turbine power and solar generation facilities.

Wastewater treatment is an energy-intensive process. The FSWWTP is first in California to be powered by wind turbines. There are four turbines rated at 50 kw (kilowatts) each which became operational in early 2010. FSWWTP property is host for a solar system owned and operated by a private solar company. The solar system has the capacity to deliver 1 mw (megawatts) of power to the treatment plant at 12 kv (kilovolts) and produces approximately 20% of electricity used by FSWWTP each year.

4. CITY OF BENICIA

Benicia processes approximately two MGD of wastewater per day at a cost of $1,202 per 100,000 gallons. There are over four hundred major plant process equipment components. They endure a severe duty cycle including continuous operation and exposure to corrosive gases and abrasive liquids. The sewer system consists of 23 lift stations, encompassing approximately 150 miles of sewer pipelines. The discharge system consists of a 1,150-foot long outfall pipeline and a 150-foot long outfall diffuser pipeline. The non-biological solids consisting of rag and grit material, which are removed before sewage treatment begins are hauled away for disposal at a cost of $5,865 for the fiscal year 2017-2018. The cost for removal and disposal of biological waste for fiscal year 2017-2018 was $209,538. Starting with fiscal year 2018-2019 the biological waste will be sold and shipped to an off-site company to be converted into fertilizer.

Benicia's wastewater treatment plant additional responsibilities include the implementation of environmental programs mandated by state and federal statutes as well as an environmental laboratory providing process control and regulatory monitoring.

Benicia has a plan to upgrade its treatment facilities to meet the needs of a nearby refinery and offset the refinery's need to consume potable water.

Methane can also be used as a fuel to generate power and/or provide process heat to optimize sludge digester functions. When methane is burned in this fashion, it converts to carbon dioxide and water. Carbon dioxide is less potent as a greenhouse gas than methane.

IV. FINDINGS AND RECOMMENDATIONS

FINDING 1

In many cases, wastewater effluent is not used to supply industrial needs or to irrigate crops and public lands.

RECOMMENDATION 1

Wastewater treatment facility decision-makers consider, on an ongoing basis, if additional treated water can be used to replace current water supplies.

FINDING 2

The Benicia and Dixon wastewater treatment plants release methane directly to the atmosphere, which could be used as fuel for co-generation.

RECOMMENDATION 2

Explore options to capture methane released by wastewater treatment, such as generating electrical power.

FINDING 3

Not all wastewater treatment plants utilize renewable sources of electrical power.

RECOMMENDATION 3

Consider solar and wind power as alternative energy sources.

REQUIRED RESPONSES
City Manager of Benicia (All Findings)
City Manager of Dixon (All Findings)
General Manager of Fairfield-Suisun Sewage District (Finding 1)
City Manager of Vacaville (Findings 1 & 3)

GLOSSARY

Clarifier: Clarifiers are settling tanks built with mechanical means for continuous removal of solids being deposited by sedimentation. A clarifier is generally used to remove solid particulates or suspended solids from liquid for clarification and thickening. Concentrated impurities, discharged from the bottom of the tank, are known as sludge, while the particles that float to the surface of the liquid are called scum.

Facultative pond: A lagoon in the pond sequence functions like the primary clarifier of a conventional sewage treatment system. Heavy solids will settle to the bottom of the lagoon, and lighter solids will float. This facultative lagoon lacks the sludge removal capability of a primary clarifier, so a population of anaerobic organisms will colonize accumulated sludge on the bottom of the lagoon.

Percolation basin: Also known as a **percolation trench**, also called an **infiltration trench**, is a type of best-management practice used to manage stormwater runoff, prevent flooding and downstream erosion, and improve water quality in an adjacent river, stream, lake or bay. It is a shallow excavated trench filled with gravel or crushed stone that is designed to infiltrate stormwater through permeable soils into the groundwater aquifer. A percolation trench is similar to a dry well, which is typically an excavated hole filled with gravel. Another similar drainage structure is a French drain, which directs water away from a building foundation, but is usually not designed to protect water quality.

Sludge: Micro-organisms that feed on organic contaminants that are in wastewater to improve effluent (discharge water).