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# SEWER USER RATE CHARGE STUDY

CITY OF PRESCOTT SEWER DEPARTMENT

JULY 2018



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# 1 INTRODUCTION

## 1.1 Purpose

The purpose of this study is to evaluate the existing user rate schedule for the City of Prescott's sewer department. The evaluation will be used to recommend user charge rate modifications that will help the City ensure funding for future sewer and wastewater facility projects. Specifically, the City is interested in developing surcharges for users who contribute excess quantities of various wastewater characteristics to the City's sanitary sewer system. These wastewater characteristics are listed below:

- Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD)
- Total Suspended Solids (TSS)
- Fats, Oils, & Grease
- Total Kjeldahl Nitrogen (TKN)
- Total Phosphorus (TP)
- pH

## 1.2 Existing Sewer User Charge Basis

The City of Prescott has an existing sanitary sewer user charge system that has been used for many years to collect revenue for the City's sewer department. Currently, 1,786 dwelling units in the City are charged for sewer usage. The dwelling units are divided into group classifications in the City. These groups include residential, multi-family, commercial, public, and industrial units.

Rates for the City's user charge system are separated into service (henceforth referred to as "Fixed") user charges and volume (henceforth referred to as "Variable") user charges. Each sewer user is assessed a combination of fixed and variable charges depending on their category classification. Chapter 470, Sub section 5 of the City's sewer ordinance outlines the criteria for four separate categories (Category A, B, C, or D). The overlaying criteria for each category is defined below.

- Category A – Users whose water usage is metered and whose discharge is representative of **normal domestic strength wastewater**.
- Category B – Users whose water usage is not metered and whose discharge is representative of **normal domestic strength wastewater**.
- Category C – Users whose water usage is metered and whose discharge is representative of **high strength wastewater**.
- Category D – Users whose water usage is metered and whose discharge is defined as **complex restaurant wastewater**.

The definitions of the listed wastewater classifications are included below in Section 1.2.1.

### 1.2.1 Existing Wastewater Definitions

General definitions of wastewater classifications are provided in the City's sewer ordinance and are used to assign categories to the City's sewer users. The major wastewater strength classifications are summarized below:

- **Normal Domestic Strength Wastewater** – In Chapter 470, Subsection 1, this is defined as wastewater with concentrations of BOD no greater than 250 milligrams per liter (mg/L), total suspended solids no greater than 200 mg/L, and phosphorus no greater than 8 mg/L.

In Chapter 470, Subsection 5, this is defined as “wastewater with concentrations of CBOD, suspended solids, nitrogen and phosphorus greater than 200, 200, 50, and 12 milligrams per liter (mg/L), respectively.

- **Extra (High) Strength Wastewater** – In Chapter 470, Subsection 1, this is defined as any wastewater that has a pollutant concentration greater than those defined for domestic strength waste and that is not otherwise defined as an incompatible waste.

In Chapter 470, Subsection 5, this is defined as wastewater with any pollutant concentrations in excess of the quantities defined for **normal domestic strength wastewater** in Chapter 470, Subsection 5.

- **Complex Restaurant Wastewater** – A separate classification assigned to sewer users who are licensed complex restaurants. These users may be assigned a separate rate, per the City's sewer ordinance. Restaurant sewer users who are licensed as non-complex restaurants have their wastewater classified as **normal domestic strength wastewater**.

Chapter 470, Subsection 1 also contains definitions for a **significant industrial user**, including, but not limited to the following:

- Any industrial user which discharges more than 25,000 gallons per day of wastewater, excluding sanitary wastewaters.
- Any industrial user that discharges a process waste stream which makes up 5% or more of the average dry weather hydraulic capacity, or more than 5% of the BOD, TSS, TKN (total Kjeldahl nitrogen), or total phosphorus treating capacity of the sewage treatment facility.

While the City's sewer ordinance discusses fats, oils, greases, and pH, there is no existing language regarding quantities of these constituents for **normal domestic strength wastewater** or **high strength wastewater**.

### *1.2.2 Existing Fixed User Charge Rates*

The fixed portion of the user charge is a quarterly base fee billed to all users of the sanitary sewer system. The City's sewer ordinance states that all sewer users are applied a fixed user charge that is based on the size of their respective water meter. As of April 2018, the fixed user charge is set at \$60.26/quarter for all sewer users. The 2017 fee schedule, provided by the City, only lists a base sewer service charge for Category A and Category B users. No separate charges are identified in the fee schedule for Category C or Category D users.

### *1.2.3 Existing Variable User Charge Rates*

The variable portion of the user charge system is defined by the City's sewer ordinance to include additional surcharges based on the volume and strength of the wastewater discharged into the sewer system. Per the 2017 user Fee Schedule provided by the City, users are charged a rate of \$4.06/1000 gallons, and additional surcharges apply for high discharge concentrations of BOD, TSS, and total phosphorus. These surcharges are as follows:

- Category B BOD > 250 mg/L = \$0.48/lb BOD
- Category B TSS > 200 mg/L = \$0.56/lb TSS
- Category B TP > 8 mg/L = \$60.26/lb TP

The high strength discharge surcharges, per the fee schedule, are listed as applicable for Category B users only. The wastewater constituents defined for high strength wastewater in Chapter 470, Subsection 1 are used as the basis for the surcharge.

Despite the Category B surcharges being listed in the fee schedule, no users are currently being assessed any of the high strength surcharges as of April 2018.

## 2 PROJECT DESCRIPTION

The current sanitary sewer user charges are being reviewed to evaluate the current charge system and if system improvements could benefit the City's sewer department. Revenue from the sewer user rates are used to provide funding for future sanitary sewer utility replacement or upgrade projects, as well as process/equipment replacement and upgrades at the City's wastewater treatment plant (WWTP). The City of Prescott's sewer department has generated positive net revenue in 2014, 2015, 2016, and 2017, but additional revenue will help continue to drive planning for future improvement projects. Additionally, it is important to ensure that the City is receiving fair compensation for what its sewer customers are discharging into the City collection system.

The goal of this project is to provide the City with recommendations for surcharges for customers discharging wastewater that exceeds the City's definition of normal domestic strength wastewater. These surcharges represent a fair way to increase revenue for the Sewer Department by increasing user rates for the users who benefit the most from the City's sanitary sewer system, rather than raising base fixed or variable charges for all users within the City.

This report will examine historical data regarding wastewater constituents within the City of Prescott and provide direction on which wastewater constituents are best suited to have excess surcharges applied. The evaluation of surcharges will utilize recent expense reports of the City's sewer department.

Based on this modeling effort, recommendations will be made to the City on how to best modify the existing sewer user rates and surcharges. No high-strength surcharges are currently being assessed to any of the City's sewer users although there is evidence that the City's WWTP is receiving waste that could be classified as high-strength according to the definitions in the City's sewer ordinance.

### 3 EXISTING WASTEWATER LOADINGS AT CITY WWTP

Data regarding influent wastewater was obtained from the City via required Discharge Monitoring Reports (DMRs) from 2014 through October 2017. The DMRs include daily influent flow rates, and sampling results of BOD and TSS concentrations, recorded three times per week. The DMRs do not contain information regarding influent TKN, TP, fats, oils greases, or pH.

In total, monthly average and daily maximum data was analyzed for influent flow rates, BOD, and TSS from 46 months of DMRs. The findings related to these constituents are presented below in the appropriate section.

#### 3.1 Influent Flow Rates (January 2014 – October 2017)

The influent flow rates must be examined in order to accurately quantify the mass loadings of influent wastewater constituents in the sanitary sewer system. The average flow rate for influent wastewater at the WWTP over the evaluation period was **0.413 MGD**. Average flow rates range from 0.361 MGD to 0.619 MGD. The single highest day flow rate during the evaluation period was 0.999 MGD.

#### 3.2 Influent BOD Loading Rates (January 2014 – October 2017)

Over the evaluation period, the **average influent BOD concentration was 211 mg/L**. When expressed as a mass loading with average flow rates, the **average BOD loading is calculated at 721 lbs./day**. This concentration is generally typical of domestic wastewater. The average BOD for the total evaluation period is below the defined BOD value from Chapter 470, Subsection 1 of 250 mg/L for normal domestic strength wastewater. A monthly average BOD concentration in excess of 250 mg/L was reported for 6 of the 46 months of the evaluation period.

The City WWTF does not report CBOD measurements on the DMRs, so no conclusion can be made whether the influent CBOD is below the value of 200 mg/L, specified for normal domestic strength wastewater in Chapter 470, Subsection 5.

There is additional evidence in the DMRs that the City WWTF is frequently treating BOD loadings in excess of the definitions provided in the City sewer ordinance. Review of daily max BOD concentrations during the evaluation period revealed that in 35 of the 45 months, at least one tested BOD sample was 250 mg/L or greater. Daily maximum BOD samples for these months had concentrations ranging from 251 mg/L to 439 mg/L. The influent BOD samples are taken at the inlet of the WWTP after complete mixing of wastewater in the City's collection system. The sampling results are evidence that there are sewer users discharging wastewater with BOD in excess of the 250 mg/L ordinance value.

### 3.3 Influent TSS Loading Rates (January 2014 – June 2017)

Over the evaluation period, the total **average influent TSS concentration was 271 mg/L**. When expressed as a mass loading with average flow rates, the average TSS loading is calculated at 926 lbs./day. The average TSS concentration is indicative of typical domestic wastewater. The average TSS for the total evaluation period is above the defined TSS value from Chapter 470, Subsection 1 & Subsection 5 of 200 mg/L for normal domestic strength wastewater. A monthly average TSS concentration below 200 mg/L was reported for only 2 of the 46 months of the evaluation period.

Review of daily max TSS concentrations revealed that at least one tested TSS sample was greater than 200 mg/L for every month of the evaluation period. Daily maximum TSS samples for these months had concentrations ranging from 210 mg/L to 1,600 mg/L. The influent TSS samples are taken at the inlet of the WWTF after complete mixing of wastewater in the City's collection system. Therefore, the sampling results are evidence that there are sewer users discharging wastewater with TSS in excess of the 200 mg/L ordinance value.

### 3.4 Influent Loading Rates for Other Constituents

As stated previously, there is no collected information on influent TKN, total phosphorus, fats, oils and greases, or pH. Textbook values are often used to estimate TKN and TP loading in collection systems where a majority of the wastewater is domestic strength.

Fats, oils, greases, and pH are harder to quantify without routine sampling data. There are no numerical defined values for surcharges for these constituents currently in the City ordinance. A basis for surcharges related to these constituents could be most easily developed with sampling data on influent wastewater at the WWTP over a period of several months to a year.

### 3.5 Analysis of Current Observed Flow and Loading Rates

The review of the available DMR data shows that BOD and TSS loadings at the WWTP are generally higher on average than the values specified in the Chapter 470 sewer ordinance for normal domestic strength wastewater. Given that there are no current major industrial wastewater contributors in the collection system, and that the WWTP is not accepting holding tank or septic waste from exterior hauling trucks, there are two probable causes for the experienced loadings:

- 1) The higher BOD and TSS loadings are indicative of more widespread use of water-efficient fixtures within homes and local businesses. These fixtures reduce the amount of water discharged to the collection system, but the quantity of constituents (BOD, TSS, etc.) in the water remains similar. As a result, the mass loadings of the wastewater constituents are higher, even though less flow is treated by the WWTP.
- 2) The higher BOD and TSS loadings could be attributed to higher discharge rates from restaurants or other businesses with grease traps that are not following proper procedures for cleaning and discharges from these units. The restaurants could also be a source of fats, oils, and greases, although these are not currently measured specifically at the WWTP.

It is also plausible that the observed higher BOD and TSS loadings are a result of a combination of the two probable causes. Additionally, it is unlikely that the Category A users and residential customers are intentionally inputting higher strength waste into the collection system. As a result, monitoring of individual residential sources and specific higher strength waste surcharges are not suitable for application towards these users. However, more stringent monitoring of customers with grease traps, along with possible source sampling for these users, may provide a better understanding of these user impacts on the overall influent wastewater loading at the WWTP.

## 4 ESTIMATED EXISTING UNIT TREATMENT COSTS

The evaluated wastewater data from Section 3, as well as current City sewer department financial information were used to generate estimates for current costs for the treatment of wastewater at the City WWTP. The estimated treatment costs were calculated on a per unit basis, which means they quantify an approximate monetary expense needed by the sewer department in order to provide treatment for a wastewater constituent quantity.

The calculated unit costs can be used as a guideline for modifying existing user fees and surcharges, as well as a basis for future industries or users that may enter the collection system service area and potentially discharge high-strength waste to the WWTP.

### 4.1 Quantification of Average Influent Wastewater Characteristics

For this study, unit treatment costs were assigned to influent flow, BOD, TSS, TKN, and TP. The unit treatment cost for each constituent is based on an average value from the period of January 2014 – October 2017. No influent data was available for influent TKN or TP, so these constituents were assumed to have constant concentrations of 25.0 mg/L and 5.0 mg/L, respectively. These values are typical of residential-strength wastewater with limited industrial contribution. The average values used for the establishment of unit treatment costs are presented in Table 4-1. Table 4-1 also shows the annual total for each constituent, which is equal to the average value multiplied by 365.

**Table 4-1**  
**Average Influent Wastewater Values, Jan. 2014 – Oct. 2017**

WASTEWATER CONSTITUENT	AVERAGE FLOW/LOADING	ANNUAL TOTAL
INFLUENT FLOW RATE	413,000 GPD	150,745,000 GAL/YR.
BOD	721 LBS./DAY	263,165 LBS./YR.
TSS	926 LBS./DAY	337,990 LBS./YR.
TKN	86 LBS./DAY	31,340 LBS./YR.
TP	17.2 LBS./DAY	6,286 LBS./YR.

The annual totals for each of the constituents are used in the calculation of the unit treatment costs, which are presented in Section 4.3.

## 4.2 Quantification of Typical Sewer Department Expenses

A number of City sewer department financial records have been reviewed for the preparation of this report. These records include revenue, expense and audit reports from 2014-2017, water billing and usage summaries from 2013-2016, and the sewer user fee schedule from 2016 and 2017. All financial information presented in this section was taken from these records. Not all of the aforementioned records are utilized in this report.

Average values for City sewer department expenses were obtained from the 2014-2017 revenue, expense, and audit reports. For the 2015 expenditure value, the \$8,696.00 sewer pension expense was discarded. Therefore, the value used for the 2015 department expenditure was \$662,014.36. For the 2014-2017 period, the average sewer department financial expense total was \$659,271, including the modification to the 2015 value.

The average expenses are categorized in Table 4-2, in accordance to classification in the department's revenue, expense, and audit reports. The values in Table 4-2 represent averages on the reported forms from the 2014-2017 period. Table 4-2 also indicates the approximate percentage of total average expenses for each expense category.

In addition to the expenses stated in Table 4-2, it is assumed there will be a separate annual expense of at least \$60,000 to be added to the City's equipment replacement fund. Additionally, \$15,000 will be used annually to contribute to debt principal payments. Thus, the current estimate for total annual department expenses is \$728,222.

**Table 4-2**  
**Typical Sewer Department Expenses by Allocation**

EXPENSE CATEGORY	2014 – 2017 AVERAGE EXPENSE	PERCENTAGE OF TOTAL
SEWER GENERAL + MAINTENANCE	\$184,668	28.3%
METER READING + MAINTENANCE	\$10,290	1.6%
SEWER EQUIPMENT REPAIR	\$7,572	1.2%
ADMINISTRATIVE	\$30,276	4.6%
ACCOUNTING	\$27,017	4.1%
OPERATING EXPENSES	\$195,970	30.0%
INTEREST EXPENSE	\$7,405	1.1%
DEPRECIATION	\$188,706	28.9%
BOND ISSUANCE	\$1,318	0.1%
<b>TOTAL</b>	<b>\$653,222</b>	<b>100%</b>

For the analysis, cost fractions were assigned for each of the expense categories for each of the evaluated wastewater constituents. The cost fractions are based on estimates and experience from prior sewer user rate evaluations. The cost fractions are presented in Table 4-3.

**Table 4-3  
Cost Fractions by Allocation**

EXPENSE CATEGORY	FLOW	BOD	TSS	TKN	TP
SEWER GENERAL + MAINTENANCE	25%	25%	25%	20%	5%
METER READING + MAINTENANCE	100%	0%	0%	0%	0%
SEWER EQUIPMENT REPAIR	100%	0%	0%	0%	0%
ADMINISTRATIVE	25%	25%	25%	20%	5%
ACCOUNTING	25%	25%	25%	20%	5%
OPERATING EXPENSES	20%	20%	20%	20%	20%
INTEREST EXPENSES	20%	20%	20%	20%	20%
DEPRECIATION	20%	20%	20%	20%	20%
BOND ISSUANCE	100%	0%	0%	0%	0%
EQUIPMENT REPLACEMENT FUND	30%	25%	25%	10%	10%
DEBT PRINCIPAL PAYMENTS	30%	25%	25%	10%	10%

The typical sewer department expenses (Table 4-2) and cost fractions (Table 4-3) were used to assign estimated annual expense costs to each of the evaluated wastewater constituents. The resulting expense costs are summarized in Table 4-4.

**Table 4-4  
Average Expenses Attributed to Constituent Treatment**

WASTEWATER CONSTITUENT	ESTIMATED ANNUAL TREATMENT EXPENSE
INFLUENT FLOW RATE	\$180,586
BOD	\$157,656
TSS	\$157,656
TKN	\$134,308
TP	\$98,014

### 4.3 Calculated Unit Treatment Costs

The annual unit treatment costs were calculated by dividing the average expenses listed in Table 4-4 by the annual wastewater constituent totals provided in Table 4-1. Table 4-5 shows the calculated unit treatment costs expressed in units of \$/1000 gallons for influent flow, and \$/lbs. loading for BOD, TSS, TKN, and TP.

**Table 4-5  
Unit Treatment Costs for Evaluated Wastewater Constituents**

WASTEWATER CONSTITUENT	ESTIMATED COST PER UNIT
INFLUENT FLOW RATE	\$1.20/1000 GALLONS
BOD	\$0.60/LBS. BOD
TSS	\$0.47/LBS. TSS
TKN	\$4.27/LBS. TKN
TP	\$15.59/LBS. TP

Table 4-6 is also included to show the approximate costs of treatment associated with every 1000 gallons of influent wastewater at the WWTP. The constituent costs shown in Table 4-6 are calculated by multiplying the unit treatment cost by the average flow rate or constituent concentration from the evaluation period. As stated in Section 4.1, the influent TKN and TP are assumed to have constant concentrations of 25 mg/L and 5 mg/L, respectively.

**Table 4-6  
Calculated Treatment Costs per 1000 Gallons of Wastewater**

WASTEWATER CONSTITUENT	COST PER 1000 GALLONS
INFLUENT FLOW RATE	\$1.20
BOD	\$1.05
TSS	\$1.05
TKN	\$0.89
TP	\$0.65
<b>TOTAL COST</b>	<b>\$4.84</b>

The calculated Total Cost of \$4.84 represents the sum of the costs associated with treatment of flow and the listed constituents for every 1000 gallons of wastewater.

## 5 CONCLUSIONS AND SUMMARY

The following conclusions can be made based on the City's current sewer user charge rates, analysis of current wastewater flows and loadings at the WWTP, and the calculated unit treatment costs stated in Section 4.

- 1) The City currently assesses a fixed charge of \$60.26/quarter and a variable charge of \$4.06/1000 gallons for all sewer users serviced by the City collection system.
- 2) Current influent BOD and TSS loadings measured at the WWTP are generally higher than the respective values specified in the Chapter 470 sewer ordinance. This is likely due to an increasing use of water-efficient fixtures in homes and businesses, waste contribution from restaurants and facilities with grease traps, or a combination of both causes.
- 3) The City's sewer department currently has annual expenses at an average of \$653,222 per year over the 2014-2017 period. Based on this value, the City spends an average of \$4.84 to treat every 1000 gallons of influent wastewater that enters the WWTP. This is higher than the existing variable user charge rate of \$4.06/1000 gallons, but does not factor revenue from the fixed portion of the user charge system.
- 4) The unit treatment costs of BOD and TSS, which were determined with 46 months of operational data, are estimated at \$0.60/lb. and \$0.47/lb., respectively. The unit treatment costs of TKN and TP, for which data is not readily available, are estimated at \$4.27/lb. and \$15.59/lb., respectively.

By comparison, the Category B surcharges listed in the User Fee Schedule for BOD, TSS, and TP in excess of the Chapter 470 values are \$0.48/lb., \$0.56/lb., and \$60.26/lb., respectively.

## 6 RECOMMENDATIONS AND CONSIDERATIONS

The following are recommended actions and considerations for the City's sewer department given the evaluations performed in this study.

- 1) Based on the observed higher BOD and TSS loadings at the WWTP, the City should consider the addition of language to the Chapter 470 ordinance regarding the maintenance and record keeping of users with registered grease traps. Users who do not comply with the requirements for grease trap upkeep may then be subject to additional surcharges, which could be added to the User Fee Schedule.

Additionally, the City could consider clarifying the definitions of "normal domestic strength wastewater" in Chapter 470 Subsection 1 and Chapter 470 Subsection 5 to ensure that the definitions are identical in both sections of Chapter 470.

- 2) In addition to adding surcharges for grease trap non-compliance, the City may wish to revise the existing User Fee Schedule to include surcharges for Category C users who may contribute high-strength wastewater to the collection system.

An initial basis for the Category C surcharges could be the estimated unit treatment costs presented in this report. The unit treatment costs are projections for how much the City pays to treat constituents, so surcharges should be minimum equal to the current estimated unit costs. The unit treatment costs can be revisited annually as new wastewater data is obtained or as sewer department expenses vary.

Similarly, the Category B surcharges in the User Fee Schedule could be revisited given the presented unit treatment costs.

- 3) When planning for regular user rate increases, it is recommended that the City apply rate increases towards the fixed charge component rather than the variable charge. If water-efficient fixtures continue to become more widespread in the future, flows may continue to decrease. Increasing the fixed charge component is a financially conservative approach and will ensure revenue for the sewer department even if sewer flows decrease.
- 4) The City has been provided with a copy of the spreadsheet used to calculate the existing unit treatment costs for the wastewater flow and loading constituents. The spreadsheet also contains tools for modeling increases in unit treatment costs in order to pay for future utility improvement projects or WWTP upgrades.