



# SEWER COLLECTION SYSTEM ANALYSIS

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CITY OF CHICO

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# Sewer Collection System Analysis

The sewer collection system is comprised of a strategic network of pipes underground that collect wastewater from homes and businesses, ultimately carrying this waste out to the Water Pollution Control Plant (WPCP) several miles outside of City limits, to be treated and disposed. Similar to roadways, sewer pipes are classified based on their intended capacity designs. Due to the nature of sewer flows, as pipes further out from the WPCP get closer, more users are also discharging waste, resulting in larger diameter pipes being needed. Pipe classifications are defined as follows (In accordance with Chico Municipal Code Section 15):

- Trunk Lines: Any pipeline greater than, or equal to fifteen (15) inches in diameter.
- Main Lines: Any sewer constructed in a street, a sewer easement, a public utility easement or a public service easement, which is less than fifteen (15) inches in diameter and designed to accommodate a system of sewer laterals.
- Laterals: That part of the sewer piping between a building waste disposal system (i.e. plumbing) and a sewer main or sewer trunk line.

Due to the engineering design and use of topography in Chico, the system is mostly comprised of a gravity system, meaning we utilize the energy of gravity to flow this wastewater to the desired destination, without mechanical support. In total, the City of Chico has approximately 400 miles of sewer pipes. In areas where the gradient is not lower and a gravity fed system does not work, sanitary sewer lift stations are utilized. Lift stations provide a mechanical pump system to force water that cannot flow via gravity, to its desired location. The City of Chico has 14 lift stations existing in our network. Lift stations have additional maintenance costs and increased failure potential compared to gravity systems.

The piping material has changed over the decades, with modern technologies best utilizing PVC pipe with a life expectancy of 100 years. However, with the age of many of our existing sewer pipelines, past practices were to utilize Vitrified Clay Pipe (VCP) and Asbestos-Cement Pipe (ACP), which were typically expected to have a life expectancy of 75 years, or Orangeburg pipe with a life expectancy of 60 years. Therefore, unlike roadways, maintenance and replacement costs for sewer pipes are based on replacing the lines prior to the expiration of the material properties life expectancy. Whereas roadways utilize a condition assessment to determine the appropriate treatment method, and ultimately cost. Outside of localized failures repaired by the Operations & Maintenance Department, in the past approximately 20-years, the City has only performed one sewer replacement project, which was the River Road Trunk Line Replacement project performed in 2018. As pipelines extend beyond their life, root intrusion and leaking pipes into the ground and groundwater are very common. This can lead to contaminated soils due to the high concentrations of nitrates and other chemicals hazardous to humans. Therefore, the intention of the sewer collection system is to program replacement of the lines prior to reaching their useful life. In addition, the Public Works – Operations & Maintenance personnel provide video of the existing lines on an annual basis. Should the conditions dictate replacement prior to their useful life due to various factors

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such as significant root intrusion or failed pipes, those segments will be prioritized for replacement. Failed piping results in emergency responses that result in higher costs to repair, as well as a high likelihood of groundwater contamination and/or sanitary sewer overflows (SSO's). SSO's are required to be reported to the State Water Board and if prevalent and preventable, can result in fines.

The costs associated with this section of the sewer enterprise, comprises of operating costs for city staff and consultants to do the day-to-day functions (cleaning, FOG program, TV lines, emergency repairs, planning efforts for the collection system, GIS updating/tracking, program oversight, etc), as well as the costs for replacing the aging pipelines.

The methodology used in determining the costs of maintaining the collection system are broken down into operating costs and capital replacement costs. The operating costs are premised on the industry identified and internally recognized need for staffing the overall program management and field operations to ensure a sustainable and functional sewer collection system. This includes functions such as keeping system details such as pipe sizing, locations, dates of installation, etc. in the City's GIS layers for sewer infrastructure. The capital replacement costs will include the costs for design and construction of the replacement of segments of pipe on an annual basis. These two functions will be further broken down in this report.

## **ANNUAL OPERATING COSTS:**

The annual operating costs associated with the collection system comprises of labor of city staff positions necessary for carrying out the day-to-day functions, as well as equipment needed to carry out those functions. Both the engineering and operations & maintenance departments have staffing demands in order to meet the needs of the system and ensure proper planning and implementation is done. The staffing costs presented below will also provide the funding for staffing position requests, if adopted, in future budget cycles.

The rates provided for the positions include the fully burdened costs of salary and benefits typical of City costs. In order to come up with the funding needed, typical hours per year associated with the collection system are assigned. A year of hours consists of 2,080 hours for a full-time equivalent (FTE) staff position. Some positions are assigned partial years to account for the fact that only a portion of those staff positions will be attributable to the collection system, whereas some of the maintenance worker positions in the Operations & Maintenance department reflect year-round efforts needed to perform maintenance functions and video recording of the conditions of the lines. While only portions of some of the positions are included, the other portions are included in areas such as the WPCP and Storm Water functions, to ensure full-time positions are funded 100% within the sewer enterprise.

**Annual Collection System Staffing Costs (Engineering)**

<b>Sewer program management- Engineering Staff</b>				
City Staff Position	Hours	Rates		Cost
Public Works Director	130	\$123.05		\$15,996.58
Senior Development Engineer	260	\$96.23		\$25,019.78
Senior Civil Engineer (Sewer/Stromwater)	1040	\$91.46		\$95,123.22
Senior Civil Engineer (Construction)	347	\$91.46		\$31,738.23
Associate Engineer Sewer	1040	\$72.51		\$75,407.51
Associate Engineer Capital	1040	\$72.51		\$75,407.51
Assistant Engineer	1040	\$63.49		\$66,028.98
Assistant Engineer	1040	\$63.49		\$66,028.98
GIS Analyst	520	\$58.12		\$30,222.39
Construction Inspector	1040	\$57.01		\$59,294.20
Admin Analyst (over see billing)	1040	\$72.51		\$75,407.51
<b>Total for engineering staff</b>				<b>\$615,674.90</b>

**Annual Collection System Staffing Costs (Operations & Maintenance)**

<b>Sewer program management- Operation and Maintenance Staff</b>				
City Staff Position	Hours	Rates		Cost
Public Works Director	130	\$123.05		\$15,996.58
Public Works Manager	694	\$85.37		\$59,243.55
Maintenance worker	2080	\$41.15		\$85,598.08
Maintenance worker	2080	\$41.15		\$85,598.08
Maintenance worker	2080	\$41.15		\$85,598.08
Maintenance worker	2080	\$41.15		\$85,598.08
Senior Maintenance Worker	2080	\$50.15		\$104,321.96
Senior Maintenance Worker	2080	\$50.15		\$104,321.96
Senior Maintenance Worker	2080	\$50.15		\$104,321.96
Senior Maintenance Worker	2080	\$50.15		\$104,321.96
Field Supervisor	2080	\$62.19		\$129,352.76
Utility locator	2080	\$50.15		\$104,321.96
Administrative Assistant	1040	\$48.61		\$50,552.74
<b>Total for O&amp;M staff</b>				<b>\$1,119,147.74</b>

Operating costs associated with the sewer piping network include equipment, tools and miscellaneous contract services for emergency repairs. The table below provides a breakdown of the associated costs with this section of program costs.

**Annual Collection System Operating Costs**

<b>Sewer program management - Annual Operating Costs</b>				
Item	each	Rates		Cost
f550	1	per year		\$16,666.67
f150	1	per year		\$4,300.00
Camera Van	1	per year		\$20,000.00
Camera Van	1	per year		\$20,000.00
Jet/Vac Truck	1	per year		\$33,333.33
Jet/Vac Truck	1	per year		\$33,333.33
Jet/Vac Truck	1	per year		\$33,333.33
F150	1	per year		\$4,300.00
Materials/Supplies/Safety/ Internal Servicing Allocations/Purchased Services	1	per year		\$100,000.00
<b>Total Annual Operating Costs</b>				<b>\$265,266.67</b>

Therefore, the total operating costs portion of the sanitary sewer collection system is: **\$2,000,089.31**.

**ANNUALIZED CAPITAL IMPROVEMENT PROGRAM (CIP) COSTS:**

There are approximately three-hundred-seventy-one (371) miles of sewer pipeline currently underground in the City of Chico. As new development occurs, or installation of new piping to areas currently on septic systems, the length of pipeline needed to be repaired and replaced grows. The methodology for predicting replacement costs utilizes the design life of the piping. Current standards utilize PVC pipe with a life expectancy of 100 years. Therefore, the costs to replace the installed pipe will be amortized out over 100 years. However, many existing segments of pipe were installed as early as 1906, which consisted of Vitrified Clay Pipe (VCP) or Orangeburg pipe, which had a life expectancy of between 75 and 50 years, respectively. The costs of replacing pipe segments are factored in to ensure consistent annual replacement costs, moving throughout the City. However, when it comes to actually putting together the annual project, Engineering and Operations & Maintenance staff will coordinate to television inspect and identify the worst first segments for replacement and prioritize those lines. Keeping updated records from building new lines is a critical function to ensure the data that gets transposed from “as-built” plans from new development or installation of new sewer lines to serve existing residences on septic, is a critical function. Current staffing levels and funding have not allowed for the level of detail necessary. This proposed staffing model will ensure those issues are mitigated in the future. This will also assist in responding to customer questions and concerns being experienced. The unit price costs are based on recent project costs

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experienced, so that it is formulated on real-world prices. Annual inflator increases will then be necessary to keep up with the costs of replacing these lines as construction materials and labor go up in the future, without having to re-do the complete study each year.

**ROADWAY AFTER SLURRY SEAL**



**ROADWAY WITHOUT SLURRY SEAL**



To break it down, the expected annual replacement of pipeline would consist of approximately 3.71 miles of pipeline per year (371 total miles, divided by 100 years of life). The scope of pipeline replacement typically consists of excavation of a trench to remove and replace the existing sewer line, re-connect existing laterals to the new line, placing trench backfill and compaction of material in accordance with City Standard details and then providing a slurry seal finish to the affected roadway. The addition of the slurry seal finish is to account for impacts to the roadway outside of the trench from heavy construction equipment. This is consistent with policy direction, as well as practices associated with the Nitrate Compliance Program.

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## BORE AND JACK INSTALLATION OF 36" SEWER PIPE



Based on recent pricing for all items included in a typical sewer project (i.e. mobilization, traffic control, storm water items required by law, trench excavation, pipe installation, trench replacement, pavement treatment, etc.), the average unit price per foot of pipe equates to \$494.16. This varies based on the size of pipe being replaced, however this provides a good average estimate. On top of the construction capital costs for the piping work, preliminary engineering work is necessary to prepare the job for public works bidding. These functions include the topographic surveys, utility potholing to ensure identification of utility conflicts (water, storm drainage, gas, electric and cable), design and environmental processes. These functions are all necessary in order to prepare plans, specifications and estimates (PS&E) for construction bidding by local contractors. As an industry standard for planning purposes, this is estimated at 15% of construction capital costs. In addition, construction engineering costs are necessary to provide inspection, construction engineering and materials testing as quality control (QC) and quality assurance (QA) in accordance with the City of Chico's adopted QA/QC plan. As an industry standard, this is typically estimated

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at 10% of the construction capital costs. Therefore, the breakdown of total project costs on an annual basis equate to:

Construction Capital – 19,588.80 Linear Feet (3.71 miles) @ \$494.16/LF	=	\$9,680,000
Preliminary Engineering – 15% of construction capital	=	\$1,452,000
Construction Engineering – 10% of construction capital	=	<u>\$ 968,000</u>
<b>TOTAL ANNUAL CIP COSTS</b>		<b><i>\$12,100,000</i></b>

Based on the reality of implementation of a new fee program, the intention is to reduce this amount in the first year to allow for design and construction of a slightly smaller project. After Year 1, the full annual amount would be intended to be collected so that adequate replacement of aged pipe can be done prior to failure of the lines. The recommended methodology of replacing pipe over the next 100-years and annualizing those costs makes this a consistent and cost-effective implementation for rate payers. An alternative would create a revenue stream based on the actual failure dates, dictating changing needs from year-to-year. That approach would result in a significant investment of staffing resources on an annual basis to do detailed inspections, analysis and administrative time to implement on a year-to-year basis.

#### OPEN TRENCH FOR SEWER LINE INSTALLATION





