Gray & Osborne, Inc.
CONSULTING ENGINEERS

TECHNICAL MEMORANDUM

TO:	KELLY RASMUSSEN, PUBLIC WORKS DIRECTOR
FROM:	MICHAEL JOHNSON, P.E.
DATE:	FEBRUARY 28, 2018
SUBJECT:	HIGH-STRENGTH WASTE DISCHARGE ORDINANCE, GENERAL SEWER AND WASTEWATER FACILITY PLAN CITY OF KALAMA, COWLITZ COUNTY, WASHINGTON G&O #17296.00

The purpose of this memo is to determine appropriate monthly operation and maintenance (O&M) surcharges to bill customers for the costs of treating their high-strength wastewater flows.

The Kalama Wastewater Treatment Facility (WWTF) influent wastewater is characterized by three components to quantify wastewater treatment loadings. These three major components are flow, biological oxygen demand (BOD_5), and total suspended solids (TSS). It is recommended that the ordinance not allow City customers to discharge wastewater with concentrations of BOD_5 or TSS over 300 milligrams per liter (mg/L) without approval from the City. Therefore, this memo will assume that wastewater with concentrations of BOD_5 or TSS in excess of 300 mg/L is considered high strength.

HIGH-STRENGTH O&M SURCHARGE RATES

High-strength O&M surcharge rates are based on estimates of the O&M costs associated with treating each pound of BOD_5 and TSS. Annual O&M expenses at the WWTF have been analyzed and segregated into costs associated with treating flow, BOD_5, and TSS. The total annual costs to treat BOD_5 and TSS are then divided by the total pounds treated at the City's WWTF (as recorded in daily monitoring reports) to determine unit costs ($/pound) to treat BOD_5 and TSS. The details of this analysis are documented in Attachment A.

In order to determine high-strength O&M surcharges, all wastewater O&M costs must be assigned in part or whole to flow, BOD_5, or TSS. This analysis utilizes one criterion when considering whether specific wastewater O&M costs should be included in the calculation of the high-strength O&M surcharge. This criterion is whether the O&M cost

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would be significantly impacted if higher BOD_5 or TSS loads were to occur. This analysis only includes WWTF O&M costs for inclusion in the high-strength O&M surcharges and does not include capital costs or debt service.

There are some WWTF O&M costs, such as administration costs, that are not impacted by BOD_5 or TSS loadings. WWTF O&M costs that are impacted by BOD_5 or TSS loadings and included in the high-strength O&M surcharge are: labor, electricity, polymer, and sludge disposal. Table 1 shows annual WWTF O&M costs in 2017.

TABLE 1 (1)

Annual WWTF O&M Expenses in 2017

WWTF Expenses	Annual Expense in 2017
Labor and Benefits	$251,778
Electricity	$44,970
Sludge Disposal (2)	$32,270
Polymer	$28,558
Total	**$357,576**

(1) Annual WWTF O&M expenses do not include WWTF debt.
(2) Cost of sludge disposal presented is an average of 2014 to 2017.

Attachment A includes documentation describing how WWTF labor, electricity, polymer, and sludge disposal costs are apportioned between flow, BOD_5, and TSS. The cost apportionment, in terms of percentages, is presented in Table 2.

TABLE 2

WWTF O&M Expenses Apportioned into Flow, BOD_5, and TSS Expenditures

WWTF Expenses	% Flow	% BOD_5	% TSS
WWTF Labor	58%	35%	7%
WWTF Electricity	27%	60%	14%
Sludge Disposal	0%	40%	60%
Polymer	0%	40%	60%
All Other	100%	0%	0%

Using the annual O&M expenses listed in Table 1 and the allocation percentages listed in Table 2, the total cost of annual WWTF O&M associated with treating BOD_5 and TSS can be calculated. Table 3 shows the resulting total annual WWTF O&M costs that are attributable to BOD_5 and TSS.

TABLE 3 (1)

Total Annual WWTF O&M Expenses Apportioned into Flow, BOD_5, and TSS

WWTF Expenses	Flow Cost	BOD_5 Cost	TSS Cost	Total
Labor and Benefits ($/year)	$146,031	$88,122	$17,624	$251,778
Electricity ($/year)	$12,142	$26,982	$5,846	$44,970
Sludge Disposal ($/year)	$0	$12,908	$19,362	$32,270
Polymer ($/year)	$0	$11,423	$17,135	$28,558
Total Annual Cost ($/year)	**$158,173**	**$139,435**	**$59,967**	**$357,576**
Total Daily Cost ($/day)	**$433**	**$382**	**$164**	**$980**

(1) Flow, BOD_5, and TSS costs are calculated by multiplying the respective allocation percentages in Table 2 by the annual expense for the respective WWTF O&M expense in Table 1.

The annual average influent BOD_5 and TSS values during the time period of analysis were 484 lb BOD_5/day and 535 lb TSS/day, respectively, based on the data reported in the WWTF daily monitoring reports. Therefore, the unit cost to treat a pound per day of BOD_5 is the total daily O&M cost associated with BOD_5 from Table 3 of $382 divided by the average annual pounds of influent BOD_5 of 484 lb/day. The resulting cost to treat a pound per day of BOD_5 is $0.79/lb/day. Similarly, the unit cost to treat a pound of TSS is $0.31/lb/day.

ATTACHMENT A

OPERATION AND MAINTENANCE COST ALLOCATION FOR KALAMA WASTEWATER TREATMENT FACILITY BASED ON FLOW, BOD_5, AND TSS

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OPERATION AND MAINTENANCE COST ALLOCATION FOR KALAMA WASTEWATER TREATMENT FACILITY BASED ON FLOW, BOD_5, AND TSS

INTRODUCTION

This attachment allocates O&M costs based on flow, BOD_5, and TSS. This attachment is organized as follows:

Operation and Maintenance Cost Allocation
- Labor Cost Allocation
- Electricity Cost Allocation
- Sludge Disposal Cost Allocation
- Polymer Cost Allocation

O&M COST ALLOCATION

Labor Cost Allocation

The City has provided a summary of wages and benefits received for the two full-time employees at the WWTF. These wages and benefits fall under three categories: Sewer Maintenance, Sewer On-Call, and Sewer Ops. The total burdened labor cost of the two full-time employees amounted to $251,778 in 2017.

The allocation of labor hours among various treatment plant tasks was determined as outlined in the 1973 EPA manual, *Estimating Staffing for Municipal Wastewater Treatment Facilities*. The estimated annual labor hours for the Kalama WWTF components are listed in Table A-1.

TABLE A-1

Annual Labor Hours at Design Flow as Estimated by EPA Method

No.	Labor Category (per EPA Manual)	Estimated Annual O&M Hours at 0.8 mgd Design Flow (per EPA Method)
1	Raw Sewage Pumping at Plant	320
2	Screening	60
3	Grit Removal	200
4	Secondary Clarification	340
5	Ultraviolet Disinfection (1)	310
6	Aeration	900
7	Aerobic Digestion	100
8	Sludge Thickening	300
9	Supervisory	460
10	Clerical	40
11	Laboratory	500
12	Yardwork	400
Total Hours		**3,930**

(1) Labor hours for ultraviolet disinfection were assumed to be similar to labor hours for chlorination.

Each labor category was evaluated to determine the impact that an increase in flow, BOD_5, or TSS would have on the labor cost. Existing O&M costs are paid for by a flow-based charge; therefore, the costs for any labor category that would not be affected by an increase in BOD_5 or TSS are allocated to flow. A cost allocation for each labor category is presented below.

Labor Category 1 – Raw Sewage Pumping at Plant

An increase in flow would result in an increase in raw sewage pumping O&M labor costs due to the increase in the number of pumps running and the increase in pump run time. However, an increase in BOD_5 or TSS would have no effect on raw sewage pumping labor costs. Therefore, 100 percent of labor costs for raw sewage pumping were allocated to flow.

Labor Category 2 – Screening

Changes in influent flow, BOD_5, or TSS would not significantly affect the amount of O&M labor expended on screening. Therefore, 100 percent of labor costs for screening and grinding were allocated to flow.

Labor Category 3 – Grit Removal

Changes in influent flow, BOD_5, or TSS would not significantly affect the amount of O&M labor expended on grit removal. Therefore, labor costs for grit removal were assigned 100 percent to flow.

Labor Category 4 – Secondary Clarification

An increase in BOD_5 or TSS would result in an increase in secondary clarification O&M labor costs due to increased RAS/WAS pump run time and increased sludge production. The role of BOD_5 and TSS in secondary sludge production was determined above for the capital cost allocation to be 90 percent BOD_5 and 10 percent TSS. An increase in flow would have no effect on secondary clarification labor costs, assuming both secondary clarifiers are always in service. Therefore, 90 percent of labor costs for secondary clarification were allocated to BOD_5 and 10 percent to TSS.

Labor Category 5 – Ultraviolet Disinfection

The EPA staffing handbook does not have a category for ultraviolet (UV) disinfection, so it was assumed that UV disinfection O&M labor costs are similar to chlorination O&M labor costs. Changes in influent flow, BOD_5, or TSS would not significantly affect the amount of labor expended on UV disinfection. Therefore, 100 percent of costs for this labor category were allocated to flow.

Labor Category 6 – Aeration

An increase in influent BOD_5 (or TKN) would result in an increase in aeration labor O&M costs due to increased blower run time because of the resultant additional bio-oxidation and bacterial growth and added process control requirements. An increase in flow or TSS would have a negligible effect on aeration labor costs. Therefore, 100 percent of labor costs for bioaeration were allocated to BOD_5.

Labor Category 7 – Aerobic Digestion

An increase in BOD_5 or TSS would result in an increase in aerobic digestion labor costs due to increased recirculation pump run time and increased digester aeration requirements. The role of BOD_5 and TSS in aerobic digester O&M labor was determined to be 40 percent BOD_5 and 60 percent TSS. An increase in flow would have no effect on aerobic digestion labor costs. Therefore, 40 percent of labor costs for anaerobic digestion were allocated to BOD_5 and 60 percent to TSS.

Labor Category 8 – Sludge Thickening

An increase in BOD_5 or TSS would result in an increase in sludge thickening labor O&M costs due to the increase in waste activated sludge production at an equivalent amount to

that of aerobic digestion. However, an increase in flow would have no effect on sludge thickening labor costs. Therefore, 40 percent of labor costs for sludge thickening were allocated to BOD_5 and 60 percent to TSS.

Labor Categories 9 Through 12 – Supervisory, Clerical, Laboratory, and Yardwork

Changes in influent flow, BOD_5, or TSS would not significantly affect the amount of labor in these categories. Therefore, 100 percent of labor costs in these categories were allocated to flow.

Allocation of Total Labor Costs at Treatment Plant

Table A-2 summarizes the allocation of labor costs between flow, BOD_5, and TSS for the treatment plant.

TABLE A-2

Allocation of Labor Costs Between Flow, BOD_5, and TSS

No.	Labor Category (per EPA Method)	Annual Hours (per EPA Method)	% Flow	% BOD_5	% TSS
1	Raw Sewage Pumping at Plant	320	100%	0%	0%
2	Screening	60	100%	0%	0%
3	Grit Removal	200	100%	0%	0%
4	Secondary Clarification	340	0%	90%	10%
5	Ultraviolet Disinfection (1)	310	100%	0%	0%
6	Aeration	900	0%	100%	0%
7	Aerobic Digestion	100	0%	40%	60%
8	Sludge Thickening	300	0%	40%	60%
9	Supervisory	460	100%	100%	0%
10	Clerical	40	100%	0%	0%
11	Laboratory	500	100%	0%	0%
12	Yardwork	400	100%	0%	0%
Total		**3,930**	**58%**	**35%**	**7%**

(1) Labor costs for ultraviolet disinfection were assumed to be similar as labor costs for chlorination.

The allocation of labor costs between flow, BOD_5, and TSS for the treatment plant based on the total yearly labor costs are:

- Flow: $146,031 per year
- BOD_5: $88,122 per year
- TSS: $17,624 per year

Electrical Cost Allocation

The City has provided a summary of electricity bills between 2014 and 2017. In 2017, the WWTF used 549,000 kilowatt-hours at a cost of $44,970.

Increases in BOD_5 and TSS loading to the treatment plant will result in increased electrical consumption by the blower motors, the secondary clarifiers, and the sludge handling equipment. A summary of the estimated electrical cost allocation for the WWTF equipment between flow, BOD_5, and TSS is presented in Table A-3. These estimates are based on the equipment motor horsepower and estimated motor usage for each piece of equipment.

TABLE A-3

Allocation of Electricity Costs Between Flow, BOD_5, and TSS

No.	Equipment Item	% Electrical Usage	% Flow	% BOD_5	% TSS
1	Influent Pumps	7.5%	100%	0%	0%
2	Aeration Basin Blowers	48.8%	0%	100%	0%
3	Aerobic Digester Blowers	20.3%	0%	40%	60%
4	Secondary Clarifiers	0.8%	0%	90%	10%
5	RAS Pumps	3.3%	0%	90%	10%
6	WAS Pumps	0.3%	0%	90%	10%
7	Secondary Clarifier Scum Pump	0.1%	0%	50%	50%
8	Ultraviolet Disinfection	3.3%	100%	0%	0%
9	Non-Potable Water Pumps	4.1%	100%	0%	0%
10	Recessed Impeller Centrifugal Pump	0.5%	0%	50%	50%
11	Grit Classifier	0.1%	0%	0%	100%
12	Sludge Transfer Pump	0.5%	0%	50%	50%
13	Screen Press	1.4%	0%	50%	50%
14	Other Electrical	9.1%	100%	0%	0%
Total		**100%**	**24%**	**62%**	**14%**

The allocation of electrical costs between flow, BOD_5, and TSS for the treatment plant based on the total yearly electrical costs are:

- Flow: $12,142 per year
- BOD_5: $26,982 per year
- TSS: $5,846 per year

Sludge Disposal Cost Allocation

The cost of contracted sludge disposal was estimated as an average of annual disposal costs between 2015 and 2017 to be $32,270.

Increases in BOD_5 and TSS loading to the treatment plant will result in increased sludge disposal costs. The contribution of flow, BOD_5, and TSS to sludge production was estimated at 0 percent flow, 40 percent BOD_5, and 60 percent TSS. The allocation of sludge disposal costs between flow, BOD_5, and TSS for the treatment plant based on the total yearly sludge disposal costs are:

- Flow: $0 per year
- BOD_5: $12,908 per year
- TSS: $19,362 per year

Chemical Cost Allocation

The annual cost of chemicals, including polymer (resin) and sodium hydroxide, was estimated using the value from the annual budget in 2017 to be $28,558.

Increases in BOD_5 and TSS loading to the treatment plant will result in increased polymer cost at the same rate as the increase in sludge disposal costs. The contribution of flow, BOD_5, and TSS to sludge production was estimated at 0 percent flow, 40 percent BOD_5, and 60 percent TSS. The allocation of polymer costs between flow, BOD_5, and TSS for the treatment plant based on the total yearly polymer costs are:

- Flow: $0 per year
- BOD_5: $11,423 per year
- TSS: $17,135 per year

All Other Costs

All other costs that fall outside of the four categories listed above will continue to be paid for by the current flow-based rate structure.