

Technical Memorandum TM-02
CITY OF PATEROS
WASTEWATER GENERAL SEWER PLAN AND FACILITIES PLAN
Flow and Loading Projections
April 13, 2022

1.1 Introduction

This Technical Memorandum (TM) provides an estimate of future flows and loadings to be treated at Pateros' wastewater treatment plant. The estimate is based on projected population growth within the sewer service area and flows and loadings currently entering the treatment plant.

Sanitary sewer flows that enter the treatment plant include the following components:

- Residential and commercial flows from the city sewer service area
- Industrial (food processing) flows from the Chelan Fruit Coop (Apple House)
- Infiltration and inflow (I/I) from the sewer collection system

Varela met with City staff in February of 2022 to discuss population growth and distribution within and beyond the City's Urban Growth Boundary. Population and growth information provided in this TM was gathered based on 2020 US Census Bureau data, Office of Financial Management (OFM) data, and discussions with City staff. Refer to TM-01 "Planning Areas and Population" for further discussion regarding the City's selected population growth projections.

This TM evaluates current flows and loadings to the City's treatment plant using Daily Monitoring Reports (DMR's) between January 2016 and December 2021. Historical and current flows and loadings are used to develop per capita ratios for influent flow, biochemical oxygen demand (BOD) and total suspended solids (TSS). The calculated per capita ratios are used with population projections to estimate future flows and loadings to the treatment plant. Future industrial flows and collection system I/I are estimated separately and added to the projected City flows.

Population projections and the sewer service area are developed in TM-01 Planning Areas and Population. That technical memo is under review by the City. For the

Population projections for Pateros are developed in TM-01 *Planning Areas and Population*. That technical memo provides projected population based on: 1) OFM projections, and 2) City identified growth areas. TM-01 is under review by the City. For wastewater planning purposes and representing plant capacity OFM projections are used herein and are shown below. Once the City decides on final projected population for 2042, this memo will be updated accordingly.

Existing population (City Limits):	593
Projected 2042 population:	730
Annual Growth Rate:	0.95%

1.2 Treatment Plant Influent Flows and Loadings

Influent flows include sewer flows provided from City daily monitoring reports (DMR's) and from the Apple House fruit processing and storage plant discharge reports provided by the City. Influent also includes infiltration that enters the collection system.

Wastewater flows are measured at the treatment plant's effluent V-Notch weir located downstream of all treatment processes. Effluent samples are taken from a sample tap on the 10" effluent line downstream of the UV disinfection system.

The current 2015 NPDES permit (WA0020559) requires the City to report influent flow daily, influent BOD₅ and TSS once per week and influent pH five times a week. Effluent pH and temperature are measured five times a week while effluent dissolved oxygen (DO), BOD, and TSS are measured weekly.

Influent flows and loadings from January 2016 through December 2021 are used to determine seasonal trends and develop per capita ratios for influent flows and loadings. **Figure 1** graphs monthly influent flows for this time period and **Table 1** summarizes this information. The DMR data indicates that influent flows have decreased slightly over the study period.

Table 1 Wastewater Influent Flow

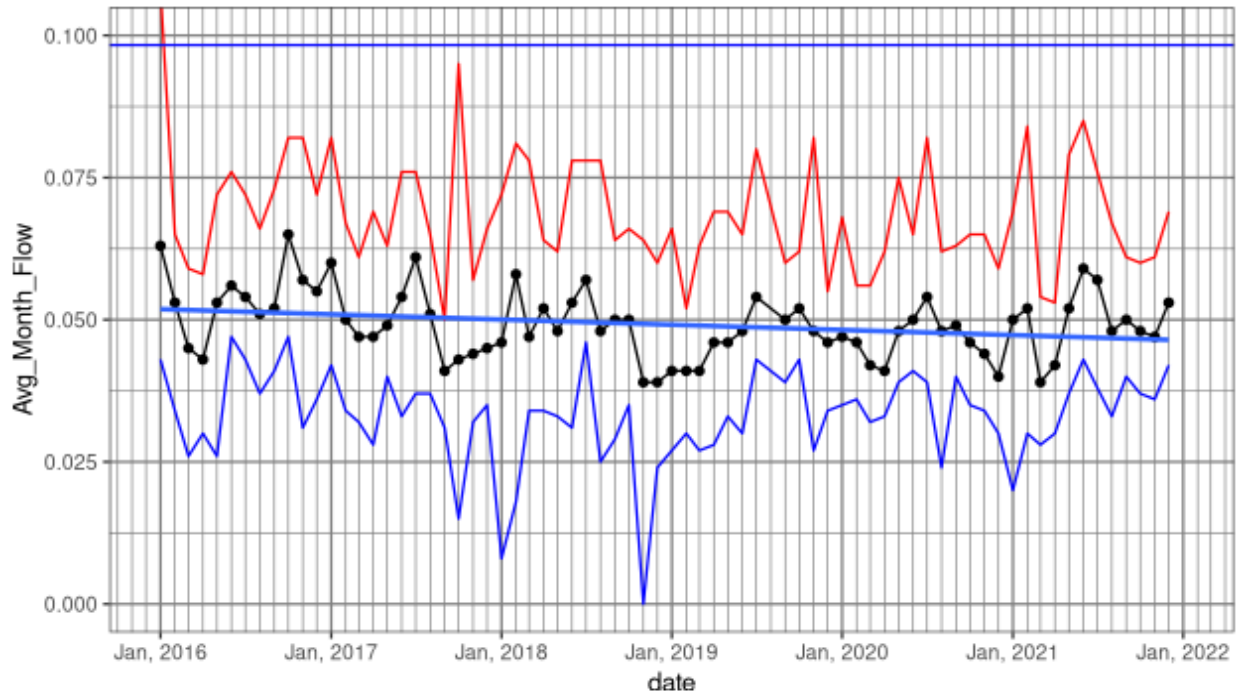
Year	AAF (MGD) ⁽¹⁾	Maximum Month		Maximum Daily	
		MMF (MGD) ⁽²⁾	Peaking Factor	MDF (MGD) ⁽³⁾	Peaking Factor
2016	0.054	0.065	1.20	0.108	2.00
2017	0.049	0.061	1.24	0.095	1.94
2018	0.049	0.058	1.18	0.081	1.65
2019	0.047	0.054	1.15	0.082	1.74
2020	0.046	0.054	1.17	0.082	1.78
2021	0.050	0.059	1.18	0.085	1.70
Average	0.049	0.059	1.189	0.089	1.80
Maximum	0.054	0.065	1.245	0.108	2.00

1. AAF = Average Annual Flow

2. MMF = Maximum Month Flow

3. MDF = Maximum Daily Flow

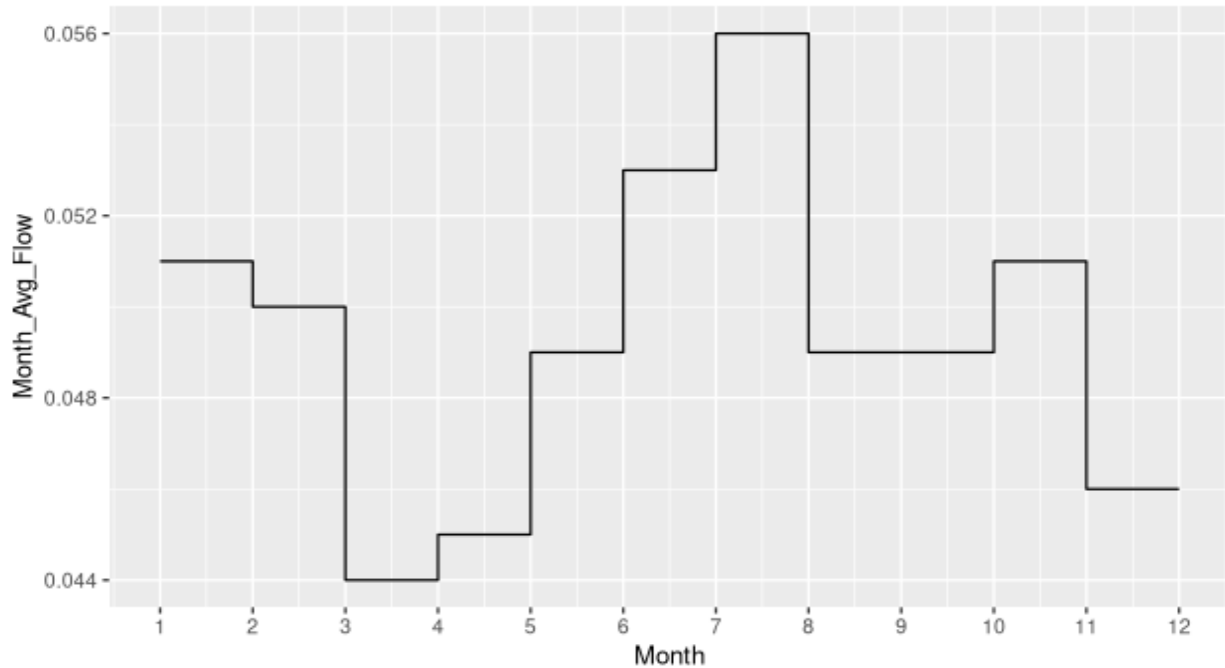
Figure 1 Pateros Monthly Influent Flows from 2016 to 2021



1. Red – Monthly Peak Flow MGD
2. Black – Average Monthly Flow (MGD)
3. Blue – Trend line for Average Monthly Flow (MGD)

Figure 2 shows the seasonal variation in monthly average influent flow for each month between 2016 and 2021. As shown on the figure, average peak influent flows occur in July with low influent flows occurring in March and April. This is an unusual flow pattern; indicating that influent flow is potentially responding to infiltration from high groundwater levels due to the water surface elevation of Lake Pateros associated with Wells Dam. Seasonal variation is not very large with the average monthly low flow about 80% of the average winter peak month flow.

Figure 2 Pateros Seasonal Flows (MGD)



Influent BOD and TSS concentrations are measured weekly. **Table 2** and **Figure 3** show BOD and TSS loadings for January 2016 through September 2021. Annual influent BOD has shown a slight decrease during the study period as did influent flow.

Table 2 Influent BOD and TSS Loading

Year	Avg. Annual BOD ₅ (lbs/d)	Max Month BOD ₅ (lbs/d)	Avg. Ann. TSS (lbs/d)	Max Mo. TSS (lbs/d)
2016	116	169	93	122
2017	101	135	93	125
2018	99	112	89	113
2019	97	127	75	95
2020	96	114	83	114
2021	97	131	91	138
Average	101	131	87	118
Maximum	116	169	93	138

Figure 3 Average Month BOD Loading (lbs/d)

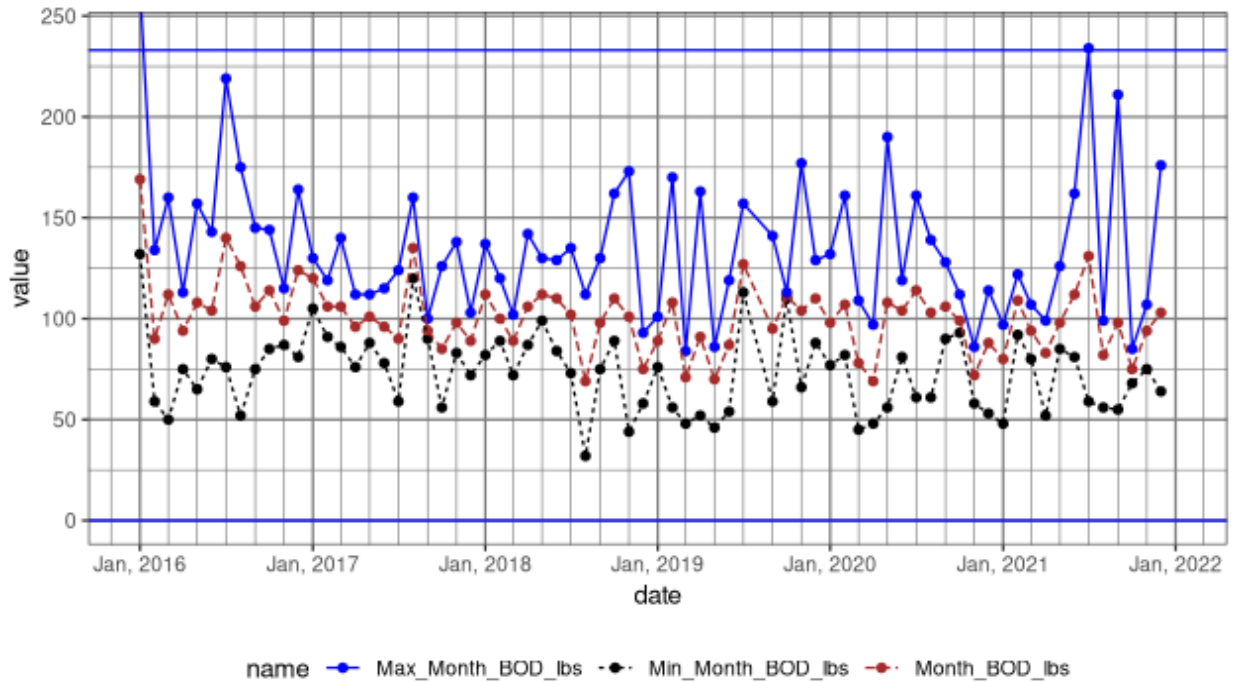


Table 3 provides a summary of influent flows and loadings and calculates a per capita ratio for influent flow, BOD, and TSS. These ratios are used to estimate future influent characteristics.

The per capita flows and loadings shown in **Tables 3** to **5** are based on influent measurements. The impact of industrial sewage from Apple House and on future flows and loadings are discussed in the next sections. 2020 flow characteristics are shown because the 2020 census population is available.

- Population (2020) = 593
- Average Daily Flow = 78 gpcd
- Max Month Flow = 91 gpcd
- Average Daily BOD = 0.16 lbs per capita/d
- Max Month BOD = 0.19 lbs per capita/d
- Average Daily TSS = 0.14 lbs per capita/d
- Max Month TSS = 0.19 lbs per capita/d

Table 3 Influent Flow per Capita

Year	Pop	Minimum Month		Average Month		Maximum Month		Peak Day	
		Flow (MGD)	Per Capita	Flow (MGD)	Per Capita	Flow (MGD)	Per Capita	Flow (MGD)	Per Capita
2016	560	0.043	77	0.054	96	0.065	116	0.108	193
2017	580	0.041	71	0.049	84	0.061	105	0.095	164
2018	583	0.039	67	0.049	84	0.058	99	0.081	139
2019	585	0.041	70	0.047	80	0.054	92	0.082	140
2020	593	0.04	67	0.046	78	0.054	91	0.082	138
2021	590	0.039	66	0.05	85	0.059	100	0.085	144
Average		0.041	70	0.05	85	0.06	101	0.09	153
Peak		0.043	77	0.05	96	0.07	116	0.11	193

Table 4 Influent BOD per Capita

Year	Pop	Minimum Month		Average Month		Maximum Month	
		BOD (lbs/d)	Per Capita	BOD (lbs/d)	Per Capita	BOD (lbs/d)	Per Capita
2016	560	90	0.16	116	0.21	169	0.30
2017	580	85	0.15	101	0.17	135	0.23
2018	583	69	0.12	99	0.17	112	0.19
2019	585	70	0.12	97	0.17	127	0.22
2020	593	69	0.12	96	0.16	114	0.19
2021	590	75	0.13	97	0.16	131	0.22
Average		76	0.13	101	0.17	131	0.23
Peak		90	0.16	116	0.21	169	0.30

Table 5 Influent TSS per Capita

Year	Pop	Minimum Month		Average Month		Maximum Month	
		TSS (lbs/d)	Per Capita	TSS (lbs/d)	Per Capita	TSS (lbs/d)	Per Capita
2016	560	60	0.11	93	0.17	122	0.22
2017	580	66	0.11	93	0.16	125	0.22
2018	583	61	0.10	89	0.15	113	0.19
2019	585	49	0.08	75	0.13	95	0.16
2020	593	54	0.09	83	0.14	114	0.19
2021	590	66	0.11	91	0.15	138	0.23
Average		59	0.10	87	0.15	118	0.20
Peak		66	0.11	93	0.17	138	0.23

1.3 Industrial Flows and Loadings

Process wastewater from the Apple House Warehouse and Storage Inc., Pateros North Plant discharges to the City treatment plant. The Apple House discharges under the Fresh Fruit Packing General Permit WAG 435152 and a 2020 City contract.

The city contract includes a base rate equivalent to 20 ERU's (1 ERU = 175 gpd) with a base wastewater strength of 2,000 mg/l BOD and 2,000 mg/l TSS. The contract with the City increases discharge costs for additional flow and strength if they occur. Apple House added pretreatment in order to reduce effluent suspended solids in early 2020. Pretreatment reduced peak loads that had been experienced before the system was installed. When discharging to the City, Apple House provides weekly flows and concentrations of BOD and TSS. Flow and concentration information is used to estimate flows and loadings in MGD, and pounds on a weekly basis in order to compare to measured City influent flows. **Figures 4 to 6** shows the Apple House flows and loads entering the City treatment plant. **Table 6** summarizes the annual loading from Apple House.

Figure 4 Apple House Flows to the Treatment Plant

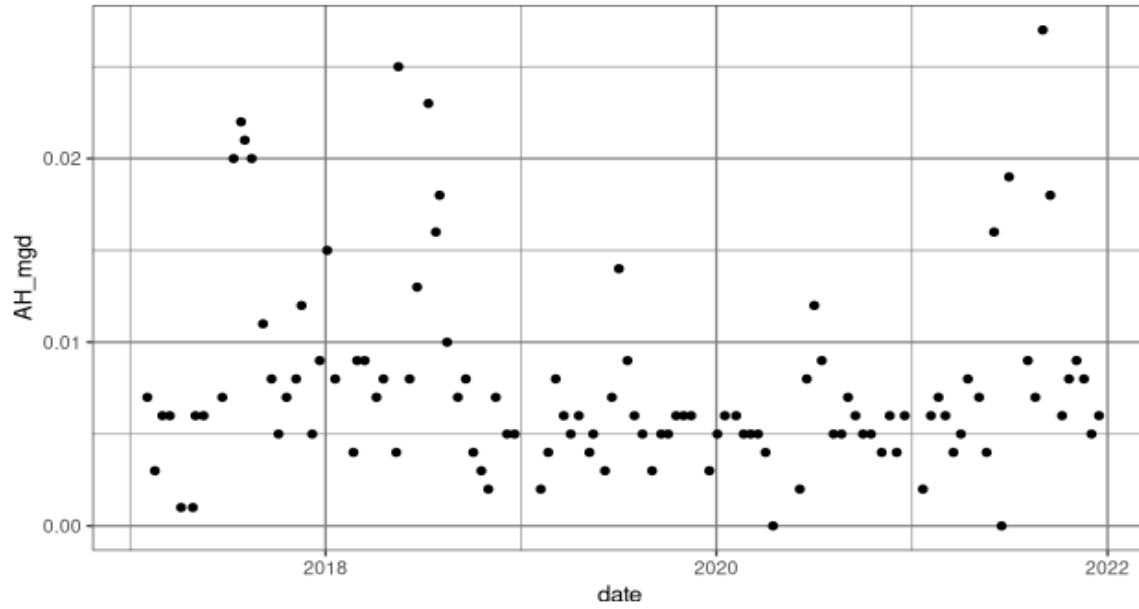


Figure 5 Apple House BOD to the Treatment Plant

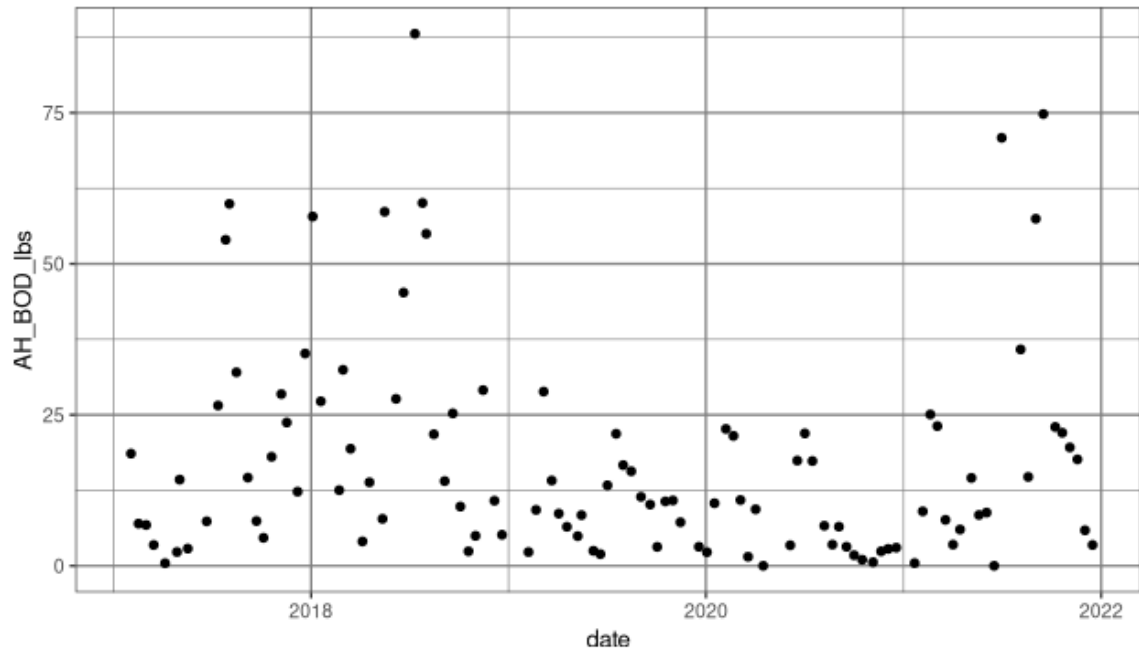


Figure 6 Apple House TSS to the Treatment Plant

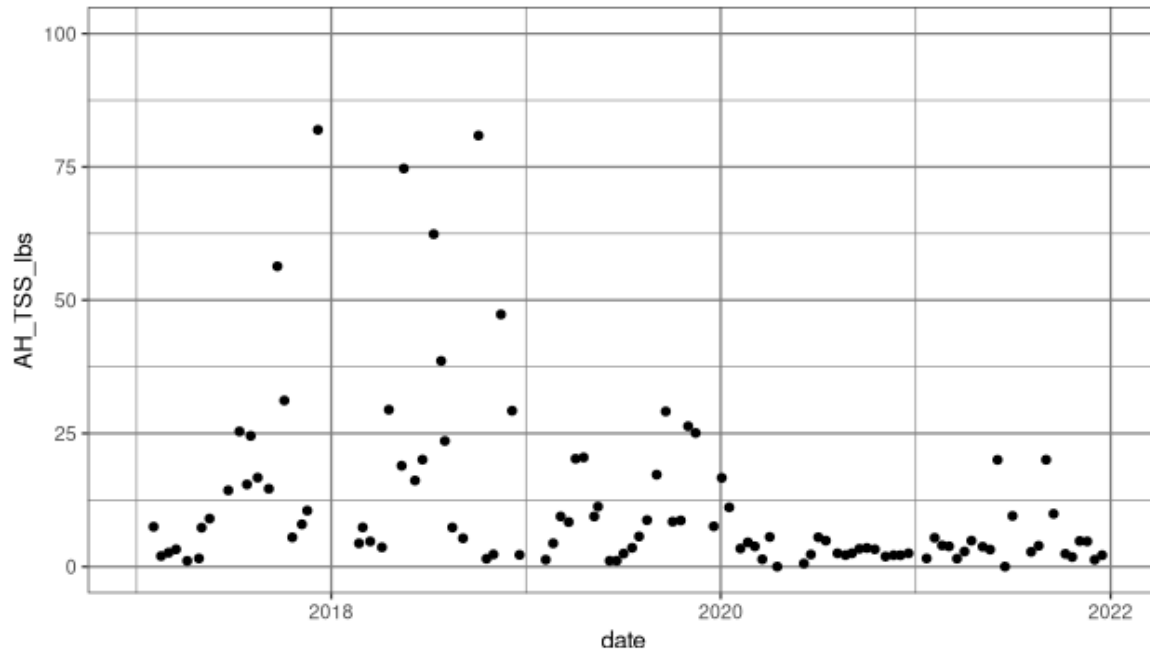


Table 6 Apple House Wastewater Contribution

Year	Flow (MGD)			BOD (lbs/d)			TSS (lbs/d)		
	Plant Influent	Apple House	% Apple House	Plant Influent	Apple House	% Apple House	Plant Influent	Apple House	% Apple House
2017	0.049	0.009	18.4%	101	18	17.8%	93	31	33.3%
2018	0.049	0.009	18.4%	99	28	28.3%	89	59	66.3%
2019	0.047	0.006	12.8%	97	9	9.3%	75	11	14.7%
2020	0.046	0.005	10.9%	96	8	8.3%	83	4	4.8%
2021	0.05	0.009	18.0%	97	21	21.6%	91	5	5.5%
Average	0.048	0.008	15.7%	98.0	16.8	17.1%	86.2	22.0	24.9%

During the study period, Apple House contributed about 16% of the flow, 17% of the BOD load, and 25% of the TSS load to the city treatment plant. As shown in **Table 6**, the TSS load from Apple House has decreased substantially after installing the pretreatment system in early 2020.

Per capita flows and loads to the treatment plant, as shown in **Table 3**, would be reduced by about 15% if Apple House did not discharge to the City treatment plant. However, the per capita flows and loadings shown in **Table 3** appear to be reasonable factors to estimate future plant loads.

1.4 Inflow and Infiltration

The City’s collection system was originally installed in 1954 and expanded in 1966. There are about 2.5 miles of AC pipe, 1.3 miles of concrete pipe, and 0.4 miles of PVC pipe in the collection system. I/I was reported at about 19% of influent flow in the 2015 NPDES Fact Sheet.

Seasonal peak flows occur in June and July as shown on **Figure 2**. This is possibly caused by Wells Dam backwater that is reportedly at an elevation higher than portions of the sewer collection system.

A check of I/I between 2016 and 2021 was made by calculating the difference between the highest and lowest month average influent flows as outlined in the ECY “Information Manual for Treatment Plant Operators”. This method is used for the Annual I/I Report prepared by treatment plants as part of their annual wastewater report used to track potential I/I issues. **Table 7** summarizes these calculations. Based on this information, excess flows from I/I contribute between 30 and 40 percent of annual influent flow. The ADF per capita is lower than the EPA guideline of 120 gpcd for excessive infiltration. A separate TM has been prepared to evaluate I/I in more detail.

Table 7 Estimated I/I Flows

Variable	Year					
	2016	2017	2018	2019	2020	2021
Min Month (MGD)	0.043	0.041	0.039	0.041	0.04	0.039
Avg Month (MGD)	0.054	0.049	0.049	0.047	0.046	0.05
Max Month (MGD)	0.065	0.061	0.058	0.054	0.054	0.059
Peak Day (MGD)	0.108	0.095	0.081	0.082	0.082	0.085
Population	560	580	583	585	593	590
Precip (in)	13.05	11.24	10.26	7.78	6.77	7.72
<u>Total (MG)</u>	<u>19.7</u>	<u>17.9</u>	<u>17.9</u>	<u>17.2</u>	<u>16.8</u>	<u>18.3</u>
I/I (MGD)	0.022	0.02	0.019	0.013	0.014	0.02
ADF/Cap (gal)	96	84	84	80	78	85
MMF/Cap (gal)	116	105	99	92	91	100
I/I/cap (gal)	39.3	34.5	32.6	22.2	23.6	33.9
% I/I/ADF	41%	41%	39%	28%	30%	40%

1.5 Potential Brew Pubs

The City has indicated that they are planning for up to two brew pubs. We have some planning information for a recent brewery located in Twisp. The initial data indicates that the Twisp brewery is planning on producing up to 400 barrels (12,000 gallons) per month. The preliminary data from the brewery’s engineer indicated a waste flow of about 2,200 gpd with an average BOD load of 50 lbs/d and TSS load of 15 lbs/d.

This appears to be pretty high production rate for a dedicated brew pub so let’s assume that each brew pub will produce a conservative 100 barrels/day or a total of 200 barrels. This adds a projected 1,100 gpd, 25 lbs of BOD and 8 lbs of TSS to the projected flows and loadings shown below.

1.6 Projected Flows and Loadings

Projected flows and loadings are estimated using projected future populations and flow and loading parameters from the current influent monitoring. In Pateros, treatment plant influent flows include municipal flows (residential and commercial), industrial flows (Apple House is the only large industrial flow), and seasonal inflow and infiltration (I/I). Future projections are shown based on the per capita flows and loadings summarized in **Tables 3 to 5**.

Table 8 summarizes the criteria used to estimate future flows and loadings. Typical flow values for new residential are approximately 100 gpcd. To be conservative a value of 120 gpcd was used for future flows after 2010.

Table 8 Annual Projected Flows and Loadings from Future Sewer Service Area

Flow or Loading	Historic	Criteria	Type	Projected (2042)	Apple House ⁽¹⁾	Brewpub ⁽¹⁾	Combined	Design
Service Area Population	593			730 ⁽²⁾				725
Avg Annual Flow (mgd)	0.050	84	gpcd	0.06	0.008	0.0011	0.071	0.125
Max. Month Flow (mgd)	0.060	1.2	PF	0.07	0.020	0.0011	0.095	0.098 (P)
Max. Day Flow (mgd)	0.090	1.8	PF	0.11	0.020	0.0011	0.132	0.180
Peak Hour Flow (mgd)	---	3.2	PF	0.26	---	0.0011	0.260	0.580
Annual Avg BOD Load (lbs/d)	101	0.17	lbs/d/cap	124	17	25	166	
Max. Month BOD Load (lbs/d)	131	0.22	lbs/d/cap	161	70	25	256	233 (P)
Annual Avg TSS Load (lbs/d)	87	0.15	lbs/d/cap	107	8	10	125	
Max Month TSS Load (lbs/d)	118	0.20	lbs/d/cap	145	15	10	170	288

1. Apple House flows and loadings are incorporated in the residential per capita factors providing conservative per capita factors. Industrial flows and loadings that include Apple House and potential brewpubs are also added as sperate flows. Max month for Apple House is based on 2021 data; there were two months where Apple House discharged high BOD. Peaking was ignored for the potential brewpubs.

2. See Section 1.1. The City is reviewing TM-01 Planning and Population concurrent with this memo. This table will be updated after the City selects final growth projections. OFM (high series) population projections used in this table in the interim.