SECTION 8

TREATMENT PLANT ANALYSIS AND RECOMMENDATIONS

8.1 INTRODUCTION

The purpose of this section is to evaluate the wastewater treatment facility and to develop recommendations for modifications to the treatment plant. The recommendations are for the purpose of assuring that the City of Sedro-Woolley will continue to meet their discharge permit requirements as well as provide for less labor intensive maintenance and operation of the treatment plant.

8.2 GOALS AND OBJECTIVES

The primary objective used in the development of the recommendations is meeting the NPDES Permit requirements established by DOE. This includes projecting the point in time when the City will probably need to begin planning to increase the treatment plant capacity. The secondary objective used in developing the recommendations is increased ease of treatment plant operation, redundancy, efficiency, and flexibility.

8.3 EXISTING PLANT FLOWS AND TREATMENT EFFICIENCY

The present system, as described in Section 7, consists of headworks, oxidation ditch, secondary clarifiers, UV disinfection, and solids treatment and dewatering. The plant discharges to the Skagit River. Solids are treated, dewatered and hauled offsite for land disposal. Details of each unit process are included in Table 7-2 along with the design criteria from DOE and the capacity of the process based on those criteria. Historical flow data for the plant is included in Table 8-1 and Figure 8-1.

Figure 8-1
Monthly Average Flow Data

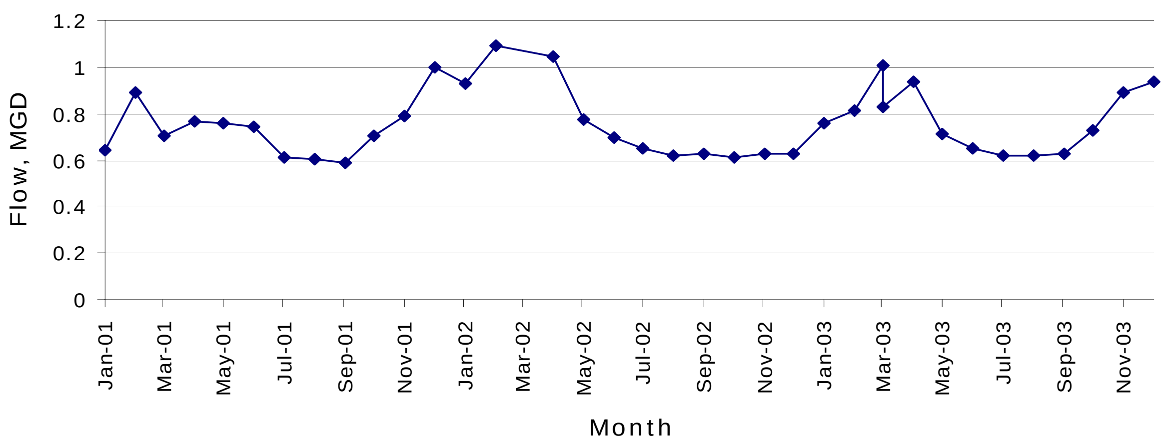

Table 8-1
City of Sedro-Woolley
Existing Treatment Plant Flow Data

Year	Month	Flow		Influent BOD		Influent TSS		Effluent BOD		Effluent TSS		Coliform
		Average	Maximum	mg/l	lbs	mg/l	lbs	mg/l	lbs	mg/l	lbs	#/100 ml
Permit Limits			*2.07*		*4160*		*4750*	*30*	*518*	*30*	*518*	*200*
2001	January	0.639	0.924	218	1151	144	778	4.2	22.2	6.6	35.8	5.9
	February	0.888	1.364	209	1454	182	1301	5.4	35.5	5.9	40.8	13.3
	March	0.705	0.909	259	1507	149	891	5.3	30.9	5.2	31.1	7.7
	April	0.764	0.987	224	1371	144	917	4.4	27.6	4.7	30.7	4.6
	May	0.760	1.066	187	1180	179	1135	4.5	29.3	4.8	32.0	8.8
	June	0.742	1.545	213	1320	188	1206	3.6	22.9	4.9	32.3	4.3
	July	0.614	0.699	264	1348	204	1057	3.0	14.0	4.0	19.0	5.1
	August	0.604	0.786	302	1593	207	1069	4.5	23.8	5.1	26.3	15.2
	September	0.591	0.749	270	1358	206	1050	6.0	29.0	9.0	49.0	16.0
	October	0.708	1.031	233	1333	172	1013	5.4	34.3	12.0	74.7	18.9
	November	0.792	1.205	104	1342	151	1026	4.0	26.0	5.0	36.0	4.1
	December	0.995	1.934	202	1538	120	963	3.0	27.0	5.0	39.0	7.0
	Average	0.734	1.100	224	1375	170	1034	4.4	26.9	6.0	37.2	9.2
2002	January	0.928	1.491	178	1324	131	952	3.0	24.0	4.0	31.0	2.0
	February	1.091	2.102	159	1251	113	942	5.0	38.0	6.0	94.0	5.0
	March	1.009	1.283	172	1496	110	945	4.0	31.0	4.0	33.0	6.0
	April	1.043	1.360	138	1198	110	956	3.0	29.0	5.0	46.0	3.0
	May	0.777	0.978	236	1540	179	1201	4.0	27.0	6.0	42.0	3.0
	June	0.698	0.885	173	1010	202	1178	5.0	30.0	6.0	33.0	2.0
	July	0.654	0.809	265	1420	252	1405	6.0	31.0	3.0	15.0	1.0
	August	0.620	0.807	253	1311	179	963	3.0	15.0	3.0	14.0	1.0
	September	0.626	0.768	293	1485	255	1374	4.0	20.0	7.0	36.0	1.0
	October	0.609	0.715	233	1159	258	1330	5.0	26.0	5.0	24.0	1.0
	November	0.629	0.979	261	1399	189	1032	5.0	25.0	13.0	79.0	1.0
	December	0.625	0.766	274	1500	202	1103	4.0	21.0	8.0	44.0	4.0
	Average	0.776	1.079	220	1341	182	1115	4.3	26.4	5.8	40.9	2.5
2003	January	0.755	0.984	258	1601	276	1865	6.0	38.0	8.0	51.0	7.0
	February	0.815	1.073	279	1769	322	2165	4.0	29.0	10.0	68.0	4.0
	March	0.828	1.074	166	1166	343	2397	8.0	53.0	9.0	68.0	13.0
	April	0.934	1.184	238	1811	176	1349	5.0	42.0	9.0	68.0	10.0
	May	0.713	0.799	352	2082	291	1773	5.0	29.0	7.0	45.0	2.0
	June	0.654	0.759	322	1748	246	1361	10.0	55.0	8.0	44.0	3.0
	July	0.616	0.672	332	1710	274	1434	6.0	33.0	6.0	33.0	1.0
	August	0.616	0.665	273	1419	214	1120	4.0	25.0	4.0	22.0	6.0
	September	0.626	0.737	325	1687	260	1401	6.0	33.0	9.0	48.0	9.0
	October	0.727	1.097	239	1449	211	1308	5.0	30.0	7.0	42.0	2.0
	November	0.892	1.889	218	1555	211	1478	4.0	35.0	7.0	47.0	4.0
	December	0.934	1.568	211	1537	182	1388	6.0	46.0	5.0	41.0	2.0
	Average	0.759	1.042	268	1628	251	1587	5.8	37.3	7.4	48.1	5.3
3-Year Average		0.756	1.073	237	1448	201	1245	4.8	30.2	6.4	42.1	5.7
Maximum		1.091	2.102	352	2082	343	2397	10.0	55.0	13.0	94.0	18.9
0.85 times permit			1.760		3536		4038	25.5	440.3	25.5	440.3	170.0

The historical flow data shows treatment plant flows are at approximately half of the permitted flow levels. The maximum month data is shown in Table 8-2.

Table 8-2
City of Sedro-Woolley
Maximum Month Flow and Loading Data

Year	Influent Flow MGD	Influent Loading lbs/day BOD	Influent Loading Lbs/day TSS
2001	0.995	1538	963
2002	1.091	1251	942
2003	0.934	1811	1349
Three year average	1.006	1533	1084
85% of Permit Limit	1.76	3536	4038

Flows and solids loadings are well below the limits set by DOE at which a wastewater treatment plant must begin planning for wastewater facility upgrades. The NPDES permit limits are not exceeded, and treatment efficiency far exceeds that required by the permit. While not exceeding the permit limits, in February of 2002 the peak daily flow was 2.102 MGD, which is larger than the average daily flow (ADF) for the maximum month. The treatment plant is generally operating well below its permit limits. Table 8-3 shows the capacity limits of each unit process using current DOE criteria.

Table 8-3
City of Sedro-Woolley
Existing Treatment Plant Capacity

Unit Process	Firm Capacity based on DOE Criteria	Limiting Issue
Influent Pumps	8.064 MGD	One unit standby
Grit Removal	2.4 MGD	one unit standby
Screenings Removal	6.0 MGD	one unit standby
Oxidation Ditch	3.01 MGD at 30 lb BOD/1000cf	Loading 5 to 30 lb BOD/d/1000cf
	4.431 MGD at 8 hr HRT	HRT 8 to 36 hours
Aeration	2.4 MGD with existing rotors	aeration - Oxygen transfer to meet demand
Secondary Clarifiers	2.31 MGD one, 4.62 MGD two average flow	overflow rate 700 gpd/sf average
	4.62 MGD one, 9.24 MGD two peak flow	overflow rate 1400 gpd/sf peak
	2.1 MGD one clarifier, 4.2 MGD two	solids loading rate 20-32 lb MLSS/d/sf
Anoxic Tank	108 minute detention time	
UV Disinfection	Average flow 2.2 MGD	UV firm capacity
	Peak flow 7.2 MGD	
Effluent Pump Station	7.2 MGD	one unit standby
RAS Pumps	1.92 MGD at 1.5 return rate	Recycle rate 0.75 to 1.5
	3.84 MGD at .75 return rate	
WAS pumps	12,800 gpd at 1.5 % solids, annual average	firm capacity
	20,800 gpd at 1.5% solids, max month	firm capacity
Aerobic Digestors		Class B, 60 day SRT at 15 degrees C
Gravity Belt Thickener	one unit, 200 gpm, 1000 lbs solids per hour	equipment capacity
Belt Filter Press	one unit, 60 gpm, 500 lbs solids per hour	equipment capacity

8.4 TREATMENT PLANT ANALYSIS

At the current time there are no flow issues relating to the treatment plant. Projected flow growth shown in Table 3-2 indicates that the estimated Peak Base Flow is 1.1 MGD in 2004 and is projected to be 1.59 in 2010. Actual Maximum Month flows for 2001-2003 shown in Table 8-1 and 8-2 match those projections very closely. Planning for the plant upgrade will need to begin as this flow approaches 85% of permit limit or 1.76 MGD. The flow projections in Chapter 3 indicate that this will happen some time after 2010. Other operational issues do require more immediate attention. Those items are discussed below.

8.4.1 Secondary Clarifiers

As discussed in Section 7.3.5, there is a flow distribution problem between the two secondary clarifiers. The newer clarifier works well on its own, but when both clarifiers are used, the flow split is not equal. Two issues appear to contribute to the poor flow split. The first is the radial velocity component of the flow entering the splitter box. The second is the effluent weir elevations. Field measurements indicate that the effluent weir elevations vary by as much as three tenths of a foot.

Clarifier Number 1 was constructed in 1973 and repaired following the floods of 1990. The working parts and “innards” date back to 1973 and should be replaced in the near future. They could be replaced and the weir elevation matched to the second clarifier weir elevation. Other issues include the small RAS removal pipe diameter that contributes to plugging. If replacement of the clarifier mechanism is not included in the capital plan, the effluent weir elevation could be adjusted to within limits without changes to the mechanism.

The radial velocity issue could be minimized by placement of a baffle in the flow-splitting box to increase the flow directed at Clarifier Number 2.

8.4.2 Clarifier Number 1 Repair

The repairs recommended in the 1996 Engineering Report by Brown and Caldwell have not been performed. Further investigation as to whether these repairs are needed should be performed. These recommended repairs included pile support of the clarifier bottom and renovation of the clarifier mechanism. The latter is discussed in Section 8.4.1 and is still recommended. The former needs further and updated investigation by a geotechnical engineer to confirm whether there are soil stabilization issues. Recent survey data indicates that the clarifier floor has settled 0.085 feet in the center since 1991. Other areas have settled or lifted slightly (less that 0.08 feet) since 1991. Yearly settlement monitoring is recommended to help determine the stability of the existing clarifier.

8.4.3 Plant Water Pumps

The plant water system installed in 1998 operates at two pressure levels, 80 psi for low pressure and 120 psi for high pressure. Two issues have been identified with this system. First, the low-pressure water pumps plug often and seem to operate poorly on the secondary effluent. Second, the high-pressure system was supposed to operate automatically on low-pressure switch, but has not done so. The plant staff operates the high-pressure pumps manually when they know they need the extra pressure for activities such as washdown.

The plant water pumps are vertical multistage centrifugal pumps. There are 4 low-pressure pumps and one high-pressure pump. The low-pressure pumps are 3 HP and the high-pressure pump is 5 HP. This type of pump was probably selected because the multistage pumps allow high pressures at low flows. The low flows per pump and high number of pumps give the plant water system flexibility to accommodate multiple uses. An alternative would be two single stage centrifugal pumps, with a larger impeller. Still operating at 3500 rpm, this pump would produce approximately twice the flow of the multistage pumps at the same head. The larger impeller would reduce the potential for plugging. One issue that would need to be addressed with this alternative is that the pump would cycle more often and would operate at a higher horsepower.

8.4.4 Sodium Hypochlorite Injection

The plant water system uses a tablet type hypochlorite injection system for chlorinating the plant water. The system is located in the upper floor of the Plant Water building. The hypochlorite fumes are causing corrosion in the building, including building features and pipe and fittings. The injection system is simple and small and could be relocated. It is recommended that the injection system be relocated outside, immediately west of the pump building. The system should be covered by a “hot box” or other enclosure, and piping should be heat traced.

8.4.5 Sump Pumps

The plant water building and the headworks and equipment building each have a basement filled with pumps and blowers. The sump pumps provided for the basement sumps are simplex units, with a capacity as shown below.

Table 8-4
City of Sedro-Woolley
Sump Pump Capacity

Location	Flow, gpm	Head, ft	Horsepower, voltage
Headworks	60	23	1/3, 230
Plant Water	20	18	1/3,115

Plant staff has expressed concern about the ability of the sump pumps to keep up with a potential flooding situation. Installation of duplex pumps or larger simplex pumps is recommended to address this concern. In addition, a high level alarm should be installed in each sump to provide staff with a warning of trouble in the area.

8.4.6 Digester Overflow

The new aerobic digesters each have two 8-inch diameter overflow lines at elevation centerline 57.5 feet. The design plans show these drain lines as open to the outside air. The plant staff has plugged these overflow lines because a sludge overflow would run onto bare dirt. In order to use the overflow lines, plant staff has requested a concrete slab be poured below the overflows. The slab should be sloped to drain to a catch basin that would be plumbed to the influent sewer.

8.4.7 Sludge Dryer

The sludge from the plant is stabilized, dewatered and hauled to disposal. Drying the sludge to Class “A” biosolids would allow disposal via other methods and would reduce hauling costs. The City of Burlington has recently installed a sludge dryer. The Sedro-Woolley staff plans to observe the City of Burlington’s experience with the sludge dryer and to analyze the cost effectiveness of a sludge dryer at the Sedro-Woolley plant.

8.4.8 Anoxic Tank

The 1998 upgrade installed an anoxic tank to allow plant staff to treat the secondary mixed liquor to promote denitrification. As flows increase over time, the models described in the 1996 Engineering report indicate that additional anoxic volume will be required to meet total inorganic nitrogen of less than 12 mg/l. The anoxic tank was installed in a portion of the former chlorine contact tank. Blowers were installed in the plant water building to provide both mixing and aeration. Plant staff has two concerns about the anoxic tank. First, the blowers seem to provide too much air when mixing. Second, the use of the anoxic tank has filled the operations building with foul odors.

Assuming that at some point in the future the anoxic stage will be required to remove nitrogen prior to discharge, several changes could be incorporated in the anoxic tank. First, mechanical mixing could be provided to reduce addition of air to the contents of the tank. Denitrification requires an anoxic period that is difficult to achieve when adding oxygen for mixing. Placement of submerged propeller mixers in the tank would allow mixing to occur when aeration is not needed. Since the tank can be drained when not needed, access to the mixers is less of an issue than it might be in a normal aeration tank.

In addition, attention should be paid to sealing cracks, penetrations and other potential access of fumes to the operations building. Positive ventilation of the anoxic tank air space could also be provided to produce a negative air pressure on the operations building. Discharge of foul air should be treated through a passive carbon scrubber or other similar system.

8.4.9 Flood Protection

The treatment plant is located within the floodplain of the Skagit River. The 100-year flood elevation is 48.0 feet. The plant buildings and tanks are located above this elevation, at 48.5 to 49 feet. Basements and tanks would still be subject to flooding. In addition, tanks and buildings could be damaged by erosion and debris. Plant staff has begun planning to install flood protection in the areas not currently protected.

8.4.10 Clarifier Number 2

Secondary Clarifier Number 2 has an issue with the scum pit not draining very well. The scum collection system was designed to drain via gravity to the RAS sludge pit. The head available to move the sludge is insufficient, unless the sludge pit is drawn down below the operating limits for suction of the RAS pumps. The scum is sent to the RAS system, which means it recycles through the mixed liquor and reappears in the clarifiers again.

Plant staff would like an investigation of a better way to move the scum from the clarifier, and to keep it removed from the flow. Renovation of the clarifier mechanism would be required to accomplish the first task. Providing scum storage and disposal facilities would be required to accomplish the second.

8.4.11 Influent Pumps

Plant staff has noticed that grit accumulates in the influent pump station immediately downstream of the influent baffle. The grit plugs the influent channel to pump P103 and causes the pump to run dry since the pump level controls are located on the other side of the pump station. Potential solutions include installing fill concrete in the pump station bottom to reduce the settlement of grit in this area, or instituting a regular pump down routine to minimize settlement.

In addition, the influent pumps are operated in a fill and draw mode, rather than variable speed. The fill and draw mode means that flow to the plant is unequal over time. Providing variable speed drives for the existing pumps could relieve some of the hydraulic “surge” on the downstream systems in the plant.

8.4.12 Reuse

The City is planning for water reuse as a means of reducing effluent discharge to the river and promote water conservation. Pursuit of reuse includes identification of nearby potential uses for treated effluent. Effluent reuse would need to follow the requirements of the Washington State Departments of Health (DOH) and Ecology (DOE). The first step in investigating reuse is called the preliminary investigation stage as defined in the DOE Criteria for Sewage works design. This stage includes fact finding in which physical, economic, institutional and legal limitation are identified. All potential sources of reclaimed water and markets should be identified. The following stages of planning include screening of potential markets and detailed evaluation of alternatives to serve selected markets, including engineering and economic feasibility, financial analysis and environmental analysis. The City of Sedro-Woolley's commitment to water reuse is demonstrated by installation of dedicated "purple pipe" intended for future transport of treated effluent. Design of the Township Street interceptor upgrade project includes installation of parallel purple pipe.

8.5 SUMMARY

The existing Sedro-Woolley treatment plant operates at approximate one half of the current capacity. Upgrades due to increases in flow or loading will not be required until flows reach 85 percent of the permit limits. Based on current flow data, it appears that planning for upgrades will not be necessary until at least 2010. Implementation of an effective I & I reduction program, as discussed in previous sections and in Appendix B, would further defer treatment plant upgrades by reducing extraneous flow and increasing available capacity. It is recommended that all future budgeting for the sanitary sewer system include I & I reduction projects and staffing levels consistent with this overall goal.

The plant operates well and meets its permit conditions. Section 8.4 describes changes that can be made to the plant to improve flexibility, reliability and operations. Table 8-5 below shows planning level cost estimates for those potential projects for the 6 year planning period. In some cases, additional planning or design work is necessary. In other cases, plant staff can incorporate the changes as needed.

Table 8-5
City of Sedro-Woolley
Treatment Plant Capital Projects and Cost Estimates

Treatment Plant Issue	Estimated Cost
Clarifier Hydraulic Issue	$42,000
Clarifier Number 1 Repair	$240,000
Plant Water Pumps	$13,200
Move Sodium Hypochlorite Injection	$9,000
Sump Pumps	$15,600
Digester Overflow	$15,930
Sludge Dryer (Class "A" Biosolids)	$90,000
Anoxic Tank Repairs	$55,200
Flood Protection	$12,000*
Clarifier Number 2 Scum Issue	$6,000*
Water Reuse Planning	$30,000*

Note: * Does not contain estimate for capital cost, just cost for initial planning.