The new grit removal system will remove 100 mesh or larger grit and is recommended to be designed around the Pista grit removal system manufactured by Smith & Loveless that was discussed in Section VII. For Phase I, a Pista Model 2.5 (peak design flow of unit is 2.5 MGD) is required to remove grit from a peak daily flow of 1.6 MGD.

Sequencing Batch Reactors

As discussed in Section VII, the recommended sequencing batch reactor (SBR) treatment process for Phase I will be comprised of two equal volume basins with each basin operating through five cycles per day for all flows up to the projected peak daily flow (PDF). Each cycle duration would be 288 minutes (4.8 hours). For the first 144 minutes of each treatment cycle an SBR basin would be in a fill phase. Following the fill phase the SBR would continue to aerate, settle, and then decant. These three phases (which would also include sludge wasting) total 144 minutes.

The Phase II SBR process would incorporate a third SBR basin into the treatment process for increased capacity and flexibility. Each basin would continue to operate through five cycles per day for all flows up to the projected PDF. Each cycle duration would remain at 288 minutes (4.8 hours). For the first 96 minutes of each treatment cycle an SBR basin would be in a fill phase. Following the fill phase the SBR would continue to aerate, settle, and then decant. These three phases (which would also include sludge wasting) total 192 minutes. Since an SBR basin does not receive any influent flow during the aerate, settle and decant cycles the other two SBR basins receive all influent flow.

Table VIII-1 presents a summary of the SBR design criteria to be used for the recommended project. SBR basins are anticipated to be cast-in-place concrete basins, however, circular basins constructed out of material such as glass-lined, bolted steel tanks may be acceptable if standard size volumes can be utilized. These type of tanks would require additional land space but may present an opportunity for capital cost savings during construction.

Table VIII-1
Design Criteria for Proposed SBR WWTP

	Phase I- 2 SBR Basin Sizing	*Phase II SBR Sizing*
Dimensions of each SBR Basin[1]	73' x 49'	73' x 49'
Minimum Volume/SBR Basin	347,852 gallons (13' SWD)	347,852 gallons (13' SWD)
Variable Volume/SBR Basin	214,063 gallons (8' SWD)	214,063 gallons (8' SWD)
Total Volume/SBR Basin	561,915 gallons (21' SWD)	561,915 gallons (21' SWD)
HRT for ADWF[2]	16.7 hours	12.5 hours
Design MLSS Concentration	4,500 mg/l	4,500 mg/l
Biological Mass in SBR Basins	26,113 lbs	39,169 lbs
Allowable Influent BOD Loading	2,475 lbs/day	3,720 lbs/day
Allowable Influent BOD Concentration For ADWF	464 mg/l	348 mg/l
Food:Mass Ratio (F:M ratio)	0.095	0.095
Solids Retention Time	13.3 days	13.3 days
MLVSS:MLSS Ratio	0.73	0.73
MLVSS Concentration	3,285 mg/l	3,285 mg/l
WAS solids generated	1,634 lbs/day	2,455 lbs/day
WAS solids concentration	0.5-1.0%	0.5-1.0%
WAS volume to digesters	19,590-39,180 gal/day	29,433-58,866 gal/day
Lbs WAS / lb BOD_5 applied	0.66	0.66
Aeration required oxygen transfer	300 lbs/aeration hour/basin	300 lbs/aeration hour/basin
Blower Size Required for aeration	2-75 Hp units[3]	4-75 Hp units[3]
Aeration Diffuser System	Coarse Bubble	Coarse Bubble
Mixing Power Required/Basin[4]	1-20 Hp turbine mixer	1-20 Hp turbine mixer
Decant Rate	3,333 gpm (4.8 MGD)	3,333 gpm (4.8 MGD)
Sludge Pump Equipment/Basin	1-3Hp pump	1-3Hp pump
Treatment Plant Process Control	Programmable PLC	Programmable PLC

1: Basin size based on 5 cycles/basin/day each cycle lasting 4.8 hours for all flows up to PDF. If flows exceed design PDF cycle times would be shortened by float switch control.
2: HRT based on total minimum volume of all SBR basins divided by MMA of 1.0 MGD for Phase I and 2.0 MGD for Phase II.
3: Phase I requires a 3rd blower unit, and Phase II requires a 5th blower unit for redundant capacity.
4: Mixing power estimated based on 40 Hp/MGD at minimum volume and 30 Hp/MGD at maximum volume.

UV Disinfection

The new UV disinfection system will be designed based on utilizing two 2.6 MGD capacity closed conduit units. These units can be installed in the effluent piping at any convenient location.

Effluent Pump Station & Gravity Discharge Pipeline

Because the SBR is a batch treatment process and the treated effluent from each batch is discharged over a relatively short time period, two new effluent pumps each capable of pumping 3,333 gpm (4.8 MGD) are required to be installed as part of the Phase I improvements. The new pumps will allow all effluent to be pumped to the Lewis River when the river flow is high. Two pumps each with the recommended capacity will provide 100% redundancy and will be capable of pumping to the river at the same rate

at which treated effluent it is decanted from the SBR basins. The pumped effluent will be discharged to a standpipe structure to be constructed within the treatment plant dike. This will allow the pumps to pump against a constant head pressure and will provide better flood protection for the plant than the existing flap gate located on the river side of the dike. During normal operation the effluent will flow to the river through a gravity pipeline. This pipeline will need to be upsized to 24-inch diameter piping to adequately pass the SBR decant flow rate.

Aerobic Digestion Facility

As discussed in Section VII, the recommended solids stabilization process is a Pre-Thickened Aerobic Digestion (PAD) facility consisting of two aerobic digesters, a pre-mix basin and a gravity thickener. The design criteria for the recommended aerobic digestion facility is summarized in Table VIII-2.

Table VIII-2
Aerobic Digester Design Criteria

Design Parameter	*1999*	*2009 (Phase I)*	*2023 (Phase II)*
Population	3,570	6,111	12,089
Total WAS to digester (lbs/day)	947	1,634	2,455[1]
VSS to digester (lbs/day)	691	1,193	1,792
Solids concentration range to digester (%)	0.5-1.0	0.5-1.0	0.5-1.0
Sludge Volume to Digester (gpd)	11,354-22,707	19,590-39,180	29,433-58,866
VSS Reduction (%)	40-50	40-50	40-50
Diffused-air mixing (ft^3/1,000 ft^3 basin volume-min)	30	30	30
Digester Basin Dimensions	45'x30'x24'	45'x30'x24'	45'x30'x24'
Pre-Mix Basin Dimensions	5.5'x35'x21.5'	5.5'x35'x21.5'	5.5'x35'x21.5'
Gravity Thickener Basin Dimensions	35' diameter	35' diameter	35' diameter
Blower capacity	3-100 Hp units[2]	3-100 Hp units[2]	3-100 Hp units[2]
Sludge airlift pumps	2 units	2 units	2 units
Sludge transfer pumps	2 units	2 units	2 units

1: Lbs/Capita/Day is reduced for 2023 population based on reduced influent loading associated with City enforcing sewer billing ordinance and developing a pre-treatment ordinance for high strength dischargers.
2: Two units required, the third unit will provide redundant capacity.
2: Tank volume shall provide a minimum of 40 days HRT at ultimate design conditions
3: Digester volume will be provided through the construction of two tanks.

Stabilized biosolids can be transferred to the existing aerobic digestion tank for interim storage and for transfer to haul trucks.

Influent & Effluent Flow Meters and Samplers

It is recommended that a new ultrasonic flow meter be incorporated into the new headworks facility. This will provide reliable flow measuring capability with data sent to a totalizer and chart recording unit. A new sampling unit should also be installed as part of the headworks facility. The sampling unit should have the capability to pull influent flow samples based either on time or influent flow rate. A transit-time flow meter is recommended to be installed on the effluent pipeline and an effluent sampling unit, similar to the influent sampler, should also be provided and installed at a convenient location on the effluent piping.

Laboratory Facility

As discussed in Section VII of this report, a new laboratory facility is required to provide adequate space for required safety equipment, lab testing equipment, a restroom facility, a changing area for plant operators, and an area for record keeping and administrative duties. The minimum recommended building footprint for a new laboratory facility is 20' x 40'. It is recommended that the building be wood framed with composite siding material and have metal roofing so that it will be resistant to water damage. The minimum equipment, furniture and accessories for the new laboratory building is listed in Table VIII-3.

Table VIII-3
Recommended Minimum Laboratory Equipment, Furniture & Accessories

Laboratory Equipment & Accessories	*No. of Units Recommended*
TSS Explosion Proof Vacuum Pump	1
Fume Hood	1
Spectrophotometer	1
BOD Incubator	1
BOD Washing Machine	1
Computer	1
Desk	1
Chair	1
File Cabinets	2
Book Case	1

WWTP PLANT STAFFING

The successful operation of any wastewater treatment facility depends on qualified personnel in adequate numbers to operate and maintain the system. This section provides an estimate of manpower requirements to operate and maintain the recommended SBR treatment plant. The estimated manpower requirements are based on EPA's *"Estimating Staffing for Municipal Wastewater Treatment Plants, 1973."* The estimate should be considered a guide and not an absolute requirement. Refinements should be made during preparation of the new plant's Operation & Maintenance (O&M) Manual, based on staff input and the specific equipment installed.

Table VIII-4 identifies the major components that will require O&M within the new facility. This estimate was then adjusted (increased or decreased) based on the following factors:

1. The new plant layout will be fairly compact. EPA recommends reducing both the annual operation and maintenance manpower requirements by 10%.

2. The laboratory manpower requirement is increased by 10% and the operations requirement is increased by 5% due to waste removal being examined in terms of both percent removal and the amount of waste in the effluent.

3. EPA recommends reducing the supervisory manpower requirement by 10% and the operations requirement by 5% if operators are certified and receive continuing education training.

4. Automatic sampling of both the influent and effluent is recommended above. EPA recommends reducing both the laboratory and operations manpower requirement by 5% if this type of sampling is provided.

5. The WWTP operations staff is also responsible for assisting with operating and maintaining the City's wastewater collection system. EPA recommends increasing both the operation and maintenance manpower requirement by 15% each in this case.

Table VIII-4
ESTIMATED WWTP STAFFING REQUIREMENTS

	SUPER.	*RECORDS*	*LAB.*	*OPER.*	*MAINT.*	*TOTAL*
Administration	700					700
Clerical		100				100
Laboratory			800			800
Yardwork					320	320
Headworks				320	40	360
SBR Basins				680	440	1,120
UV Equipment				80	40	120
Aerobic Digestion				240	100	340
Weekend/Evening Operation[1]				832		832
Subtotals	700	100	800	2,152	940	4,692
Labor Adjustments						
1. Compact Plant Layout				-10%	-10%	
2. Waste Removal Req'd.			+10%	-5%		
3. Certification/Training	-10%			-5%		
4. Automatic Sampling			-5%	-5%		
5. Collection System				+15%	+15%	
ADJUSTMENT AS %	-10%		+5%	-10%	+5%	
ADJUST. AS HOURS	-70		+40	-216	+48	-198
TOTAL O&M HOURS	630	100	840	1,936	988	4,494
NUMBER OF F.T.E.[2]	0.35	0.06	0.46	1.07	0.54	2.48

1: Hours shown for Weekend/Evening Operation are based on a total of 16 hours/week.
2: F.T.E. = Full-time employee, based on 1,816 work hours/year. This figure is based on 10 holidays, 3 weeks vacation, 1 week sick leave, and 3 days continuing education/training per year being subtracted from 2,080 hours/year.

The estimated staffing requirement for the new WWTP is 2-2.5 full-time operators. It needs to be stressed that this be considered a preliminary estimate and used as a guide for staffing the plant and not an absolute requirement.

WWTP SAMPLING AND TESTING REQUIREMENTS

A wastewater treatment plant laboratory testing program provides a basis for process control and a record of how the treatment facilities are operating. This information keeps operating personnel and regulatory agencies informed of plant efficiencies, helps in predicting problems that may develop in the plant and is used as a basis for defining future system upgrades. For these reasons it is essential that a treatment plant's laboratory sampling and testing program produce complete and accurate results.

As mentioned previously it is recommended that the upgraded WWTP include composite sampling equipment for both the influent and effluent wastewater flows. For sampling purposes, the plant should be divided into the following two "waste streams".

1. Liquid Process – The minimum recommended sampling program, including sample site locations, testing parameters, type of sample and frequency of tests is outlined in Table VIII-5.

2. Sludge Process – The minimum recommended sampling program, including sample site locations, testing parameters, type of sample and frequency of tests is outlined in Table VIII-6.

The sampling program for both the liquid and sludge processes also needs to comply with all requirements of the City's NPDES permit and applicable requirements of the *503 Regulations* and the Washington State Biosolids Rule. It may be desirable to conduct additional sampling and testing of parameters such as TKN, ammonia, nitrates, dissolved oxygen, temperature, and alkalinity to allow plant operators to optimize the treatment processes.

Table VIII-5
RECOMMENDED MINIMUM LIQUID PROCESS SAMPLING AND TESTING PROGRAM

Liquid Parameter	*Type of Sample*	*Sample Location*		*Units Results Reported In*
		Influent	*Effluent*	
Flow	Measured	Continuous	Continuous	MGD
BOD_5	Composite	Two per Week	Two per Week	mg/L
TSS	Composite	Two per Week	Two per Week	mg/L
Fecal Coliform	Grab		Two per Week	Colonies/100 mL
pH	Grab		One per Day	s.u.

Table VIII-6
RECOMMENDED MINIMUM SLUDGE PROCESSING SAMPLING AND TESTING PROGRAM

Sludge Parameter	*Type of Sample*	*WAS to Digesters*	*Digester Supernatant*	*WAS Disposed of*	*Units Results Reported In*
Flow	(1) Below	A	A	B	Gpd
TSS	(2) Below	A	A	B	mg/L
VSS	(2) Below	A	A	B	mg/L
BOD_5	(2) Below	A	A	B	mg/L
pH	Grab	One per Day	One per Day	B	s.u.
Temperature	Grab	One per Day	One per Day	B	Deg. F or C
Fecal	(2) Below			B	Colonies/100mL
Salmonella	(2) Below			B	Colonies/100mL
Ammonia	(2) Below			B	mg/Kg
Nitrate	(2) Below			B	mg/Kg
TKN	(2) Below			B	mg/Kg
Potassium	(2) Below			B	mg/Kg
Arsenic	(2) Below			B	mg/Kg
Cadmium	(2) Below			B	mg/Kg
Chromium	(2) Below			B	mg/Kg
Copper	(2) Below			B	mg/Kg
Lead	(2) Below			B	mg/Kg
Mercury	(2) Below			B	mg/Kg
Molybdenum	(2) Below			B	mg/Kg
Nickel	(2) Below			B	mg/Kg
Selenium	(2) Below			B	mg/Kg
Zinc	(2) Below			B	mg/Kg

(1) Flow for Sludge Processing Units to be Calculated As Follows:
   A. Read pump run time meter, multiply pump rate (gpm) by run time. Take readings daily.
   B. Number of trucks hauled multiplied by volume of truck. Record each truckload hauled.

(2) It is recommended to take samples during periods when transfers are occurring as suggested below:
   A. Take 100 mL for each pump cycle during day. Keep at 4 deg. C. Mix samples prior to testing. Take 1,000 mL from each truckload (keep at 4 deg. C) for one day of wasting. Mix samples prior to Testing. Sample each time sludge is disposed of.