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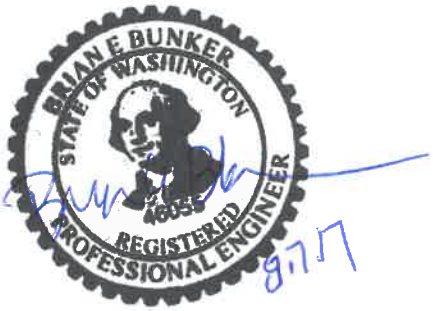
TECHNICAL MEMORANDUM



DATE:	August 7, 2017
TO:	City of Montesano
FROM:	Brandon Moss, EIT; Brian Bunker, PE
SUBJECT:	Wastewater Treatment Plant Relocation Conceptual Evaluation
CC:	Matt Kastberg
PROJECT NUMBER:	217-1678-043
PROJECT NAME:	Wynoochee River Bank Protection

1. EXECUTIVE SUMMARY

The City of Montesano's (City) Wastewater Treatment Plant (WWTP) is currently threatened by migration of the Wynoochee River toward the WWTP. Failure or loss of critical elements of the treatment plant as a result of ongoing river migration would create an expensive infrastructure and environmental disaster. This technical memorandum evaluated concepts for relocation of the WWTP, including planning level opinion of cost and schedule for the different alternatives evaluated.

The evaluation considered three alternative sites and three types of treatment technologies. The three sites were defined as "near," "middle," and "far," using distances of 0 to 500 feet, 500 to 1,000 feet, and 2,000 to 2,500 feet, respectively, from critical wastewater collection system infrastructure. The evaluation explored three different alternatives for treatment technology, including the City's current Biolac® Lagoon (Lagoon), a Sequencing Batch Reactor (SBR), and a Membrane Bioreactor (MBR). Each treatment technology evaluated is a common treatment technology used across the United States and each is capable of meeting the City's current effluent discharge limits.

In addition to the cost for constructing a new treatment facility, the evaluation included anticipated costs for property acquisition, pump stations and pipelines (required for collection system modification with treatment plant relocation), and biosolids handling capability for a new treatment plant. Costs for demolition of the existing WWTP were also included. In addition, this memo evaluated the option to maintain the City's existing WWTP through process modification and additional flood protection, as well as cost to replace the existing chlorine disinfection system with ultraviolet (UV) light disinfection.

Overall, the evaluation found that protecting the existing WWTP through process modification and additional flood protection would have the least capital cost at approximately $10 million (M), which may extend existing WWTP life up to 10 years. The existing chlorine disinfection system could be replaced with UV light disinfection for an additional $1.5M. The cost of the different alternatives (largely influenced by the combination of location and technology) for relocating the WWTP ranged from $16.7M to $30.6M, with the least expensive alternative being a Lagoon at a near location and the most expensive being an MBR facility at a far location.

For the project timeline for all alternatives, initial planning would require approximately 6 months, followed by property acquisitions and preliminary agency approvals requiring another 6 months. Design of a new treatment

plant would take approximately 1 year, followed by another year of construction. In total, it would take about 3 years from commencement of planning to completion of construction for a new WWTP.

While not quantifiable from a conceptual planning level, this memo also discussed aspects of WWTP relocation which may require special consideration and coordination before selection of any alternative. These aspects include factors such as permitting risks, flood hazards, odor consideration, future flow capacity increase, and eminent domain.

2. BACKGROUND

The existence of the City of Montesano's (City) Wastewater Treatment Plant (WWTP), located along the Wynoochee River near its confluence with the Chehalis River, is threatened by movement of the river toward the WWTP. Failure or loss of critical elements of the treatment plant would create an expensive infrastructure and environmental disaster. In 2013, the City initiated a mitigation strategy to prevent infrastructure damage or loss by constructing a sheet pile wall to protect the WWTP from flooding. To date, the ongoing migration of the Wynoochee River toward the east continues to threaten the integrity of the WWTP. Therefore, the City has retained Parametrix to evaluate the cost, schedule, and advantages/disadvantages of relocating the WWTP to an alternate location. The City has also requested the evaluation of maintaining the existing WWTP through process modification and additional flood protection, as well as a planning level opinion of cost to replace the existing chlorine disinfection system with ultraviolet (UV) light disinfection.

3. INTRODUCTION

To complete this evaluation, three distances were selected to represent potential areas within the City limits to relocate the treatment plant, defined as "near," "middle," and "far." The "near" location is approximately 0 to 500 feet from the influent pipe alignment for the existing WWTP; the "middle" location is approximately 500 to 1,000 feet from the pressure sustaining valve (PSV)/influent pipe; and the "far" location is approximately 2,000 to 2,500 feet from the PSV/influent pipe. All three areas and their relation to the existing WWTP, PSV, and influent pipe are depicted in Figure 1.

The evaluation explores three different alternatives for treatment technology, including the current Biolac® Lagoon (Lagoon), Sequencing Batch Reactor (SBR), and Membrane Bioreactor (MBR). The Lagoon technology was evaluated as if the City's current WWTP was replaced-in-kind at a new location. The City's existing Biolac® Lagoon WWTP process consists of one anoxic selector basin with three basins (two 12,000-gallon basins and one 24,000-gallon basin), a 720,000-gallon aeration lagoon, two 40-foot-diameter clarifiers, a return activated sludge/waste activated sludge (RAS/WAS) pump station (three pumps), clarifier drain pump station (two pumps), three aeration blowers, a 2,500,000-gallon solids holding lagoon, a 6,500-gallon lime slurry tank with two pumps, and an effluent pump station (two pumps). The existing WWTP also has one blower building to house the aeration blowers, a control building which contains the chlorinators, lab, workroom, and control room, and a polishing building which houses the chlorine contact basin and additional storage volume used for cleaning of the chlorine contact chamber and in cases of emergency discharge.

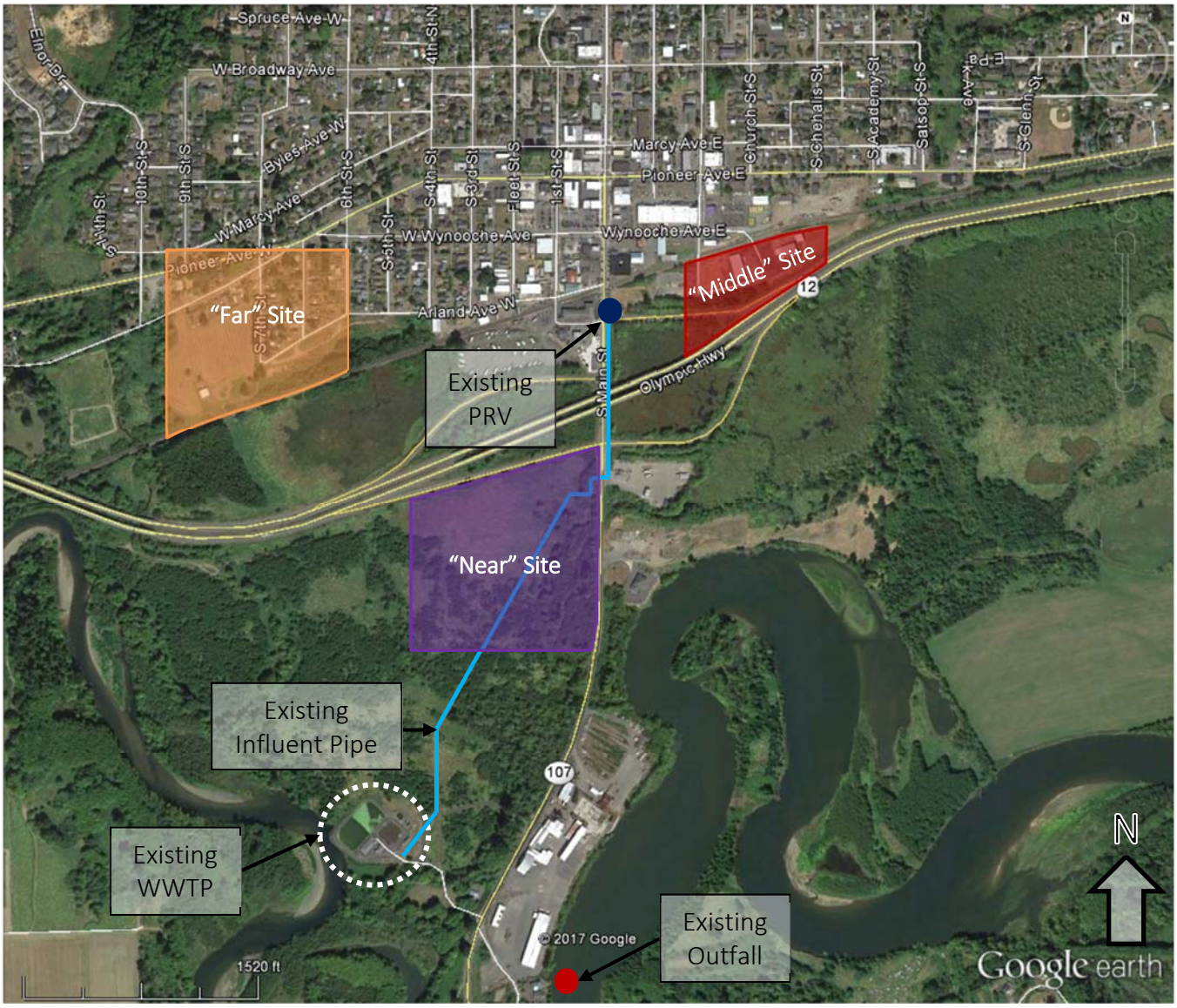


Figure 1. Vicinity Map Indicating Near, Middle, and Far Locations for a Future WWTP

SBR technology is a type of activated sludge process where wastewater is added to a single "batch" reactor, treated to remove undesirable components, and then discharged. An SBR is similar to the Biolac® Lagoon system, except that the anoxic selectors and aeration pond would be replaced by the batch reactor. MBR technology combines a suspended growth biological reactor with filtration membranes to remove undesirable components from the wastewater. MBR technology is also similar to the City's existing WWTP, except that the anoxic selectors, aeration pond, and clarifiers would be replaced by a series of concrete basins and membrane units. General process diagrams for all three treatment technologies considered in this evaluation are depicted in Figure 2. SBRs and MBRs have the option of either storing wasted biosolids on site, much like the storage lagoon at the existing WWTP, or hauling the solids off-site for additional treatment and disposal.

(a) (b) (c)

Figure 2. General Process Diagrams for (a) Biolac®, (b) SBR, and (c) MBR treatment technologies. Source: "Wastewater Engineering Treatment and Resource Recovery". 2014. Metcalf & Eddy | AECOM. Fifth Ed.

All three treatment technologies considered are commonly used within the State of Washington and across the country as reliable methods to treat wastewater. For this evaluation, each site (near, middle, far; denoted as Alternative 1, 2, and 3, respectively) was evaluated in conjunction with each treatment technology (Lagoon, SBR, MBR; denoted as A, B, and C, respectively).

A fourth alternative for salvaging the liquid stream process at the City's existing WWTP with additional process modification and flood protection was evaluated. This includes decommissioning/abandoning the biosolids lagoon, adding a biosolids handling facility, providing a loading dock for dewatered biosolids hauling, and constructing an additional shoreline barrier flood wall with log jams (referred to as Alternative 4A). Operation and maintenance (O&M) cost for the biosolids handling facility and hauling were also assessed. Lastly, planning level opinion of cost were provided for adding UV light disinfection to the existing liquid stream process, in replacement of the existing chlorine disinfection system. With UV disinfection, specialized lights emit UV radiation which damage microbial cells such that they can no longer replicate, rendering them inactive. A general process diagram for UV light disinfection is presented in Figure 3. The addition of a UV system, in addition to that which is already listed in Alternative 4A, is referred to as Alternative 4B.

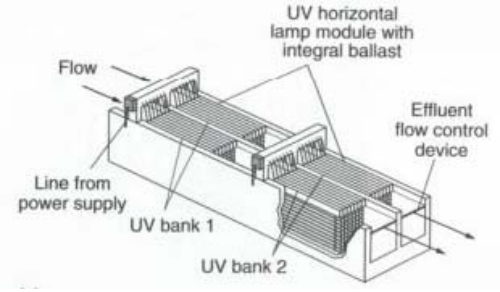


Figure 3. General Process Diagram for Non-Contact Open Channel UV Light Disinfection. Source: "Wastewater Engineering Treatment and Resource Recovery." 2014. Metcalf & Eddy | AECOM. Fifth Ed.

4. BASIS OF DESIGN ASSUMPTIONS

A baseline of assumptions was determined to ensure all sites and technologies were evaluated at an equal level. The following sections outline these basis of design assumptions.

4.1 WWTP Expected Capacity and Treatment Level

Referencing the City's current National Pollutant Discharge Elimination System (NPDES) permit (WA0024660), as well as design flow data provided by the City, the existing treatment plant has a Maximum Month Daily Flow of 350,000 gallons per day (gpd) with a Peak Design Flow of 670,000 gpd. The existing plant must also meet average

monthly effluent limits of 30 mg/L for both Biochemical Oxygen Demand (BOD_5) and Total Suspended Solids (TSS) as well as 0.5 mg/L Total Residual Chlorine. The permit requires a minimum effluent pH of 6.0 standard units and a monthly geometric mean of 200 fecal coliform bacteria per 100mL treated effluent. This information, along with the average weekly design criteria can be found in Table 1 below. Each of the three treatment technologies were selected because they are common treatment technologies and can meet these design criteria.

Table 1. Assumed Treatment Technology Design Criteria

Parameter		Flow
Maximum Month Design Flow		350,000 gpd
Peak Design Flow		670,000 gpd
Parameter	**Average Monthly**	**Average Weekly**
Biochemical Oxygen Demand (5-day) (BOD_5)	30.0 mg/L 167 lb/day 85% removal of influent BOD_5	45.0 mg/L 251 lb/day
Total Suspended Solids	30.0 mg/L 167 lb/day 85% removal of influent TSS	45.0 mg/L 251 lb/day
Total Residual Chlorine	0.5 mg/L	0.75 mg/L
Parameter	**Minimum**	**Maximum**
pH	6.0 Standard Units	9.0 Standard Units
Parameter	**Monthly Geometric Mean**	**Weekly Geometric Mean**
Fecal Coliform Bacteria	200/100 mL	400/100 mL

4.2 WWTP Solids Handling and Footprint

Currently, the City's Biolac® Lagoon treatment system stores wasted biosolids onsite in Pond #2. As such, the total footprint of the existing WWTP is approximately 3.0 acres. However, it was assumed for all alternatives that a biosolids pond would not be installed. Instead, a biosolids dewatering facility would be constructed with capacity to haul dewatered biosolids offsite for additional treatment and storage. Thus, without a biosolids pond, the total footprint of the Biolac® system would require approximately 2.0 acres. The SBR and MBR technologies were also each assumed to require about 2.0 acres of land to construct.

4.3 Connection of Future WWTP to Existing Influent Pipe and Outfall

The existing Septic Tank Effluent Pumping (STEP) system used to collect the City's wastewater ultimately combines downstream into one pipe that conveys untreated waste to the influent to the existing WWTP. There is a pressure sustaining valve (PSV) located approximately at the northeast corner of the intersection of S. Main Street and Brumfield Avenue (next to the Highway 12 West off-ramp) that marks the beginning of the combined influent pipe (see Figure 1). If a future treatment plant is to be constructed some distance from the PSV or existing influent pipe (e.g., at the "far" site), a new influent pipe from the PSV to the plant may need to be constructed. Additionally, an effluent pipe may also need to be constructed from the future plant back to the PSV.

It is advantageous to assume the new WWTP influent/effluent lines connect at or after the PSV for two reasons: (1) a new WWTP connecting prior to the PSV may require extensive collection system modifications, which increase drastically the further from the PSV the connection is placed, and (2) maintaining connection to the existing PSV/influent pipe allows for use of the existing outfall to discharge treated effluent. It is assumed that the

current outfall location would remain, thus, limiting potential NPDES permitting changes. Therefore, it was assumed that a new treatment plant influent pipe must connect at the PSV or somewhere (south) along the existing WWTP influent pipe. Additionally, it was assumed that the new pipeline to and away from a new WWTP would be constructed entirely in the right-of-way, or in an easement that would be easy to obtain.

For all three sites, it was assumed that a new pump station would be required to maintain pressure at the connection of the existing influent pipe to the existing outfall pipe (because the demolition of the existing WWTP would remove the current effluent pump station). This new pump station could be constructed to the southeast of the existing WWTP, near the existing influent and effluent pipe alignments. Additionally, for the "middle" and "far" site alternatives, another pump station would be required to maintain forcemain pressure from the PSV/existing pipe connection to the new treatment plant. In all cases, an effluent pump station at each new WWTP was already included in the construction cost (which would return treated effluent back to the existing pressured influent line).

4.4 Existing WWTP Demolition

After a new treatment plant is brought online, the existing treatment plant must be demolished. The demolition work was assumed to include dewatering the solids in the waste activated sludge lagoon and hauling the dewatered solids to a landfill. The control building, blower building, and polishing pond structure would be leveled to grade with demolished materials hauled to a landfill for disposal. It was assumed that the Douglas fir wood joists in the polishing pond structure would be salvaged; the mechanical equipment in buildings, ponds, tanks, and clarifiers would be removed; and the ponds, tanks, and clarifiers would be backfilled to grade with 2 feet of crushed stone and the remaining with sand. The existing fence would also be removed. The requirements for demolishing the existing WWTP are assumed to be the same for all alternatives analyzed.

Quantity takeoffs for the work listed above were estimated from either the 1990 or 1998 existing WWTP design drawings. Any facility improvements after 1998 may not be reflected in the values presented. Cost values were determined from literature or provided through RSMeans CostWorks 2017 software.

4.5 Property Acquisition

It was assumed that all three of the site alternatives (near, middle, far) would include equal cost and effort to acquire property, regardless of actual location and parcel size. This includes an assumed capital cost of the land at $125,000, as well as 10 percent for administrative/legal and 10 percent for inflation (to represent the cost of land at a future purchase date). The current market value of a 2.0-acre parcel in Montesano is difficult to quantify, and a land value now could change substantially based on market trends at the time of purchase. Thus, the assumed capital cost for land is purely an engineer assumption and requires further study and verification.

4.6 Preservation of Existing WWTP

For Alternative 4A (to preserve the existing WWTP as described in Section 3), it was assumed that the biosolids lagoon (Pond #2) would be abandoned and a biosolids handling facility, including solids dewatering and hauling capability, would be constructed. With this alternative, additional shoreline barriers (300-foot long, 50-foot deep flood wall with log jams and habit restoration) would be implemented to protect the plant from river migration. Furthermore, Alternative 4B also includes modification to use UV disinfection instead of chlorine disinfection. Specifically, this alternative assumed implementation of a non-contact UV system which employs highly scale-resistant flow tubes that convey effluent flow to be disinfected past dry-mounted UV lamps. It was assumed that the existing chlorine contact basin would be maintained and retrofitted with a four-bank (three operational, one standby) non-contact UV system. Three UV light banks would be used during peak flow; at lower flows, only one to two of the banks would need to operate.

Yearly O&M cost associated with the biosolids handling facility and hauling is also included in the evaluation, which assumes a cost for operation of the dewatering process, solids disposal, polymer for thickening, labor, electrical, routine repairs, and contingency.

4.7 Cost Estimation

The Engineer's Opinion of Probable Construction Cost (EOPCC) for all alternatives were based on cost information found in the literature, prior projects at Parametrix, and the engineer's best judgement. In addition to the construction cost, it is customary to add the following to any EOPCC at this milestone in the process: 8.8 percent sales tax, 30 percent contingency, 10 percent administrative/legal, and 35 percent for engineering, permitting, and construction management.

5. EOPCC

5.1 Estimated Project Cost for Each Alternative

The EOPCC for design and construction of a new WWTP, which includes a biosolids handling facility cost, design and construction of the pipeline between the new WWTP and existing PSV/influent pipe, design and construction of a new pump station(s), existing WWTP demolition, and property acquisition is summarized in Table 2 below for each of the nine alternatives. The main cost differences between the alternatives are the capital cost of the three treatment technologies and the cost required for different pipeline distances. The following sections detail the construction cost of individual components of this overall cost. Detailed descriptions of the total project costs can be found in Appendix A.

Table 2. Engineer's Opinion of Probable Construction Cost ($1,000,000)

	Site		
Treatment Technology	Near	Middle	Far
Lagoon	16.7 (Alternative 1A)	19.4 (Alternative 1B)	20.7 (Alternative 1C)
SBR	20.6 (Alternative 2A)	23.2 (Alternative 2B)	24.5 (Alternative 2C)
MBR	26.6 (Alternative 3A)	29.2 (Alternative 3B)	30.6 (Alternative 3C)
Alternative	**Existing WWTP**		
4A	10.0		
4B	11.5		

Alternative 4A, the option to maintain the existing treatment plant through the implementation of additional flood protection, decommissioning of the existing lagoon, and construction of a new solids handling facility is estimated to cost $10.0 million (M). Annual O&M costs for the new biosolids facility, in addition to what the City already spends, is estimated at approximately $0.14M (see Appendix B). Assuming these modifications extend WWTP life an additional 10 years, total cost for Alternative 4A is approximately $13.0M over the 10-year period, not taking into consideration life cycle costs or present net worth. Alternative 4B, which includes retrofitting the plant to use UV light disinfection instead of chlorine disinfection in addition to those modification from Alternative 4A, is estimated to cost $11.5M. Including O&M over a 10-year period results in approximately $12.9M for Alternative 4B.

5.2 WWTP EOPCC

5.2.1 Lagoon

Based on a 2011 EPA report on aerated lagoon ponds, as well as two reports on the construction of Biolac® Lagoon treatment systems (flow ranges of 0.35 to 0.75 MGD), the estimated cost for a new lagoon wastewater treatment plant ranges from approximately $3.6M to $5.0M. The average cost of $4.3M was used to determine the overall project cost estimate (see Appendix B for construction cost information).

5.2.2 SBR

Using cost information from two treatment plants (one of which is a recently designed facility by Parametrix) with flows ranging from 0.32 to 0.36MGD, the estimated cost for a new SBR wastewater treatment plant ranges from approximately $5.8M to $6.5M. The average cost of $6.2M was used to determine the overall project cost estimate (see Appendix B for construction cost information).

5.2.3 MBR

The cost a new MBR facility was estimated using data from the 2004 Desalination and Water Purification Research and Development Report, as well as the costs from two recent MBR facilities designed by Parametrix with flows around 0.4 MGD. The estimated cost for a new MBR facility ranges from approximately $5.4M to $11.9M. The average cost of $9.2M was used to determine the overall project cost estimate (see Appendix B for construction cost information).

5.3 Maintain Existing WWTP with Modifications and Flood Protection

Construction of a 300-foot long, 50-foot deep sheet pile wall plus engineering log jams and habitat restoration is estimated to cost $5.0M. An additional $4.0M is estimated for construction of a new biosolids handling facility, which is based on planning cost for a biosolids facility recently designed by Parametrix. The estimated cost for a UV disinfection system is approximately $1.5M (see Appendix A for cost information).

5.4 Demolition

Based on quantity takeoffs and costing information (see Appendix B) as described in Section 4.4, the cost to demolish the existing WWTP was estimated at approximately $2.2M (see Appendix B for construction cost information). Cost to demolish decommission/abandon the existing lagoon for Alternatives 4A and 4B is estimated at approximately $1.2M (see Appendix B).

5.5 Influent and Effluent Pipeline

The “near” site would require approximately 200 feet of total piping, which would cost about $75,000 in total construction cost. The “middle” site would require about 1,350 feet of total piping within the existing right-of-way and would cost about $0.5M. The “far” site would require approximately 3,150 feet of total piping within the existing right-of-way, costing about $1.2M. Appendix B contains construction cost information for each pipeline.

5.6 Property Acquisition

Using an assumed value of $125,000 to acquire land and adding 10 percent inflation and 10 percent administrative fee brings the total land acquisition cost to approximately $150,000.

5.7 Pump Stations

As discussed in Section 4.3, a new pump station(s) is also required to maintain forcemain pressure to the existing effluent outfall (or in some instances also to a new WWTP). A new pump station was assumed to cost approximately $750,000 to construct.

5.8 Operation and Maintenance (O&M)

The cost related to operating and maintaining each of the treatment technologies was not incorporated in the overall cost. However, the City could expect that O&M costs for another lagoon treatment system would be approximately the same to that which the City currently spends (around $220,000 annually). The SBR and MBR alternatives will likely be more expensive, namely because an SBR and MBR require additional controls and equipment. For comparison, an engineering report prepared by Parametrix in 2010, forecasted the life cycle costs over a 20-year period (2011-2031) for both an SBR and MBR treatment facility with capacity for about 0.3 MGD; the analysis forecasted a total annual cost of an SBR at approximately $300,000 and MBR at approximately $268,000 in the year 2017. This equates to roughly a 36 percent increase in O&M-related costs for an SBR and a 22 percent increase for an MBR.

6. SCHEDULE

The timeline for planning, property acquisitions, agency approvals, design, and construction of a new WWTP is assumed to be the same for all alternatives. Planning would require approximately 6 months, followed by property acquisitions and preliminary agency approvals requiring another 6 months. Design of a new treatment plant would take approximately 1 year, followed by another year of construction. In total, it would take about 3 years from commencement of planning to completion of construction for a new WWTP.

Demolition of the existing WWTP would follow after startup of a new treatment plant, with demolition requiring approximately 3 months. The estimated project schedule for both planning, design, and construction of both the new WWTP and existing WWTP demolition is shown in Figure 4 below.

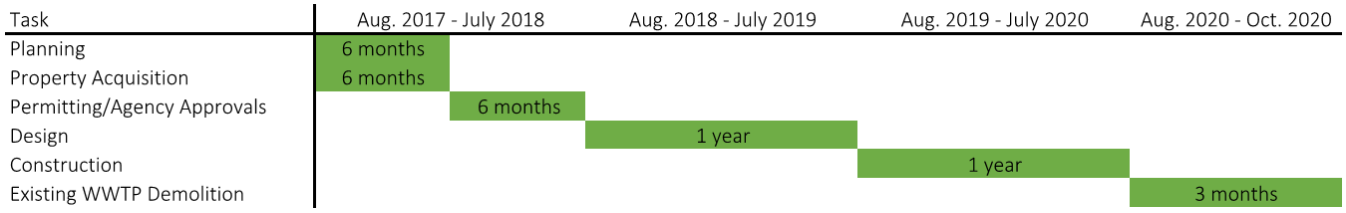


Figure 4. Estimated Project Schedule

7. DISCUSSION

Assessing each alternative for total overall estimated project costs, Alternative 4A (maintain existing liquid process, abandon lagoon, and adding biosolids handling facility) is the least expensive at $10.0M. This is followed by Alternative 4B (adding UV disinfection in addition to that described in Alternative 4A) is the next least expensive at approximately $11.5M. Alternative 1A, which includes a new Lagoon WWTP at a location near to the existing PSV/influent pipe was estimated to be the least expensive WWTP relocation option at $16.7M. The next least expensive option is Alternative 1B at $19.4M; this would be for a Lagoon treatment system at a middle location. Following this option is Alternative 2A at $20.6M, which is for a SBR at a near location. Alternative 1C, a Lagoon at a far location, is the next least expensive option at $20.7M. This is followed by Alternative 2B (SBR, middle location) at $23.2M and Alternative 2C (SBR, far location) at $24.5M. Alternative 1A (MBR, near location)

and Alternative 2B (MBR, middle location) follow at $26.6M and $29.2M, respectively. The most expensive option is Alternative 3C, which is an MBR system at a far location estimated at $30.6M.

In addition to cost, land area, and scheduling for each alternative, there are other factors which are difficult to quantify at a conceptual planning stage, but should be considered nonetheless. The follow provides an overview of these additional factors which may require special consideration and coordination before selection of any alternative.

7.1 Permitting Risk

Emergent and forested/shrub wetlands exist primarily to the south of Highway 12, as well as along the Wynoochee River to the west of Montesano. Should a future site for the WWTP be on or near a wetland area, extra permitting time and cost may be required to allow construction to take place at the desired location.

7.2 Operator Requirements

The State of Washington Department of Ecology (Ecology) maintains a wastewater operator certification program to help ensure operators can maintain a properly functioning wastewater treatment plant. The City's WWTP require an operator of at least Class II (3 years' operating experience) or higher. SBR technology also requires an operator of at least Class II; however, MBR technology would require an operator of Class III (90 relevant credits/continuing education units (CEUs) and 4 years' experience) or higher. Thus, if MBR technology is selected as the future treatment technology, the City may need to train or higher staff to meet the Class III requirement (if current staff are not already certified as Class III).

7.3 Flood Hazard

The existing WWTP, as well as much of the existing influent pipe alignment, are located within the 100-year floodplain. It is possible that the future treatment plant could be located away from the river but may still be at a site within a flood hazard area (which covers much of the area south of the City/Highway 12). Should the future plant be considered for a location within the floodplain, additional flood protection measures may be warranted to protect the plant, adding to the overall design and construction cost.

7.4 Odor

Should the future site of the WWTP be located near or in a populated portion of the city (e.g., residential or commercial), odor issues may be of concern. Treatment technology such as a lagoon has uncovered ponds and an SBR or MBR have open reactor chambers which may all emit unpleasant odors to neighboring community members. While odor can be minimized through proper design and good operating practices, elimination of odors requires additional chemical or physical treatment, typically to the odor in the vapor phase. Incorporating odor elimination technology would increase capital cost and require additional operation and maintenance needs. Odor control equipment was not included in the overall cost estimate.

7.5 Construction Considerations

If a future WWTP is to be located in a populated area of the city, traffic during construction may cause an inconvenience to local residents and businesses. Additionally, if the location is in a commercial/industrial area, it is important that access to businesses is maintained during construction. Temporary traffic control measures may be required, which would inflate project costs.

7.6 TMDL Regulations

Total Maximum Daily Load (TMDL) describes the total pollutant loading that a body of water can receive while still meeting water quality standards. Ecology currently has posted TMDLs for temperature, dissolved oxygen, and fecal coliform bacteria in the Chehalis River (location of City's current WWTP effluent outfall). TMDLs for nitrogen and phosphorous do not exist for the Chehalis River, but TMDLs for these pollutants have been implemented for surface waters elsewhere in Washington State. While this evaluation assumed a treatment level that matches the City's current NPDES permit, it would be pertinent to discuss any potential TMDL updates with Ecology during the planning phase of a new WWTP. A Lagoon technology typically does not meet strict nitrogen and phosphorous limits without addition of tertiary treatment technology. SBRs and especially MBRs typically produce a higher quality effluent to meet stricter TMDLs.

7.7 WWTP Flow Capacity Increase

This evaluation assumed no increase in flow capacity for a new WWTP (a flow of 0.67 MGD equal to current flow, was assumed). However, if the City forecasts a need for additional treatment capacity, selecting a site with the space requirements described in this report would likely not allow for future expansion. Therefore, should a flow increase be anticipated, considerations should be made in the planning stage to initially construct the plant with added capacity or ensure enough space is available to expand the plant at a later date.

7.8 Eminent Domain

This evaluation estimated a 6-month timeline for property acquisition, which assumes the purchase of property would be completed for land already available on the market. Should a suitable site be found which is not on the market, eminent domain may be necessary. Acquiring property through eminent domain could take at least 2 years to complete, based on previous experience at Parametrix. An extension to the project timeline would be required if property acquisition was completed through eminent domain.

Appendix A

Engineer’s Opinion of Probable Construction Costs

City of Montesano
Planning-Level Engineers Opinion of Probable Construction Cost
WWTP Relocation Conceptual Evaluation

Alternative 1A: Lagoon at Near Location
Prepared by: B. Moss

Item Number	Description	Quantity	Unit	Unit Price	Total
1	New WWTP	1	LS	$ 4,300,000	$4,300,000
2	New Influent/Effluent Pipes	200	FT	$ 375	$75,000
3	New Pump Station	1	LS	$ 750,000	$750,000
4	Existing WWTP Demolition	1	LS	$ 1,100,000	$1,100,000
5	Biosolids Handling Facility	1	LS	$ 2,017,925	$2,017,925
				Subtotal	**$ 8,242,925**
			Contingency	30%	$ 2,472,878
			Sales Tax	8.8%	$ 725,377
			Planning Level Construction Cost		**$ 11,441,180**
			Administration, Legal	10%	$ 1,144,118
	Engineering/Permitting/Construction Management			35%	$ 4,004,413
				Subtotal	**$ 16,589,711**
6	Property Acquisition	1	LS	$ 125,000	$125,000
	Property Inflation at 10%	1	LS	$ 12,500	$12,500
	Administration, Legal at 10%	1	LS	$ 12,500	$12,500
				Subtotal	**$ 150,000**
				PROJECT TOTAL:	**$ 16,739,711**

NOTES/ASSUMPTIONS:
Contractor installation, overhead and profit already included in construction costs

City of Montesano
Planning-Level Engineers Opinion of Probable Construction Cost
WWTP Relocation Conceptual Evaluation

Alternative 1B: Lagoon at Middle Location
Prepared by: B. Moss

Item Number	Description	Quantity	Unit	Unit Price	Total
1	New WWTP	1	LS	$ 4,300,000	$4,300,000
2	New Influent/Effluent Pipes	1,350	FT	$ 375	$506,250
3	New Pump Station	2	LS	$ 750,000	$1,500,000
4	Existing WWTP Demolition	1	LS	$ 1,100,000	$1,100,000
5	Biosolids Handling Facility	1	LS	$ 2,017,925	$2,017,925
6	Railroad Crossing	2	EA	$ 60,000	$120,000
				Subtotal	**$ 9,544,175**
			Contingency	30%	$ 2,863,253
			Sales Tax	8.8%	$ 839,887
			Planning Level Construction Cost		**$ 13,247,315**
			Administration, Legal	10%	$ 1,324,731
	Engineering/Permitting/Construction Management			35%	$ 4,636,560
				Subtotal	**$ 19,208,607**
7	Property Acquisition	1	LS	$ 125,000	$125,000
	Property Inflation at 10%	1	LS	$ 12,500	$12,500
	Administration, Legal at 10%	1	LS	$ 12,500	$12,500
				Subtotal	**$ 150,000**
				PROJECT TOTAL:	**$ 19,358,607**

NOTES/ASSUMPTIONS:
Contractor installation, overhead and profit already included in construction costs

City of Montesano
Planning-Level Engineers Opinion of Probable Construction Cost
WWTP Relocation Conceptual Evaluation

Alternative 1C: Lagoon at Far Location
Prepared by: B. Moss

Item Number	Description	Quantity	Unit	Unit Price	Total
1	New WWTP	1	LS	$ 4,300,000	$4,300,000
2	New Influent/Effluent Pipes	3,150	FT	$ 375	$1,181,250
3	New Pump Station	2	LS	$ 750,000	$1,500,000
4	Existing WWTP Demolition	1	LS	$ 1,100,000	$1,100,000
5	Biosolids Handling Facility	1	LS	$ 2,017,925	$2,017,925
6	Railroad Crossing	2	EA	$ 60,000	$120,000
				Subtotal	**$ 10,219,175**
			Contingency	30%	$ 3,065,753
			Sales Tax	8.8%	$ 899,287
			Planning Level Construction Cost		**$ 14,184,215**
			Administration, Legal	10%	$ 1,418,421
	Engineering/Permitting/Construction Management			35%	$ 4,964,475
				Subtotal	**$ 20,567,112**
7	Property Acquisition	1	LS	$ 125,000	$125,000
	Property Inflation at 10%	1	LS	$ 12,500	$12,500
	Administration, Legal at 10%	1	LS	$ 12,500	$12,500
				Subtotal	**$ 150,000**
				PROJECT TOTAL:	**$ 20,717,112**

NOTES/ASSUMPTIONS:
Contractor installation, overhead and profit already included in construction costs

City of Montesano
Planning-Level Engineers Opinion of Probable Construction Cost
WWTP Relocation Conceptual Evaluation

Alternative 2A: SBR at Near Location
Prepared by: B. Moss

Item Number	Description	Quantity	Unit	Unit Price	Total
1	New WWTP	1	LS	$ 6,200,000	$6,200,000
2	New Influent/Effluent Pipes	200	FT	$ 375	$75,000
3	New Pump Station	1	LS	$ 750,000	$750,000
4	Existing WWTP Demolition	1	LS	$ 1,100,000	$1,100,000
5	Biosolids Handling Facility	1	LS	$ 2,017,925	$2,017,925
				Subtotal	**$ 10,142,925**
			Contingency	30%	$ 3,042,878
			Sales Tax	8.8%	$ 892,577
				Planning Level Construction Cost	**$ 14,078,380**
			Administration, Legal	10%	$ 1,407,838
	Engineering/Permitting/Construction Management			35%	$ 4,927,433
				Subtotal	**$ 20,413,651**
6	Property Acquisition	1	LS	$ 125,000	$125,000
	Property Inflation at 10%	1	LS	$ 12,500	$12,500
	Administration, Legal at 10%	1	LS	$ 12,500	$12,500
				Subtotal	**$ 150,000**
				PROJECT TOTAL:	**$ 20,563,651**

NOTES/ASSUMPTIONS:
Contractor installation, overhead and profit already included in construction costs

City of Montesano
Planning-Level Engineers Opinion of Probable Construction Cost
WWTP Relocation Conceptual Evaluation

Alternative 2B: SBR at Middle Location
Prepared by: B. Moss

Item Number	Description	Quantity	Unit	Unit Price	Total
1	New WWTP	1	LS	$ 6,200,000	$6,200,000
2	New Influent/Effluent Pipes	1,350	FT	$ 375	$506,250
3	New Pump Station	2	LS	$ 750,000	$1,500,000
4	Existing WWTP Demolition	1	LS	$ 1,100,000	$1,100,000
5	Biosolids Handling Facility	1	LS	$ 2,017,925	$2,017,925
6	Railroad Crossing	2	EA	$ 60,000	$120,000
				Subtotal	**$ 11,444,175**
			Contingency	30%	$ 3,433,253
			Sales Tax	8.8%	$ 1,007,087
			Planning Level Construction Cost		**$ 15,884,515**
			Administration, Legal	10%	$ 1,588,451
	Engineering/Permitting/Construction Management			35%	$ 5,559,580
				Subtotal	**$ 23,032,547**
7	Property Acquisition	1	LS	$ 125,000	$125,000
	Property Inflation at 10%	1	LS	$ 12,500	$12,500
	Administration, Legal at 10%	1	LS	$ 12,500	$12,500
				Subtotal	**$ 150,000**
				PROJECT TOTAL:	**$ 23,182,547**

NOTES/ASSUMPTIONS:
Contractor installation, overhead and profit already included in construction costs

City of Montesano
Planning-Level Engineers Opinion of Probable Construction Cost
WWTP Relocation Conceptual Evaluation

Alternative 2C: SBR at Far Location
Prepared by: B. Moss

Item Number	Description	Quantity	Unit	Unit Price	Total
1	New WWTP	1	LS	$ 6,200,000	$6,200,000
2	New Influent/Effluent Pipes	3,150	FT	$ 375	$1,181,250
3	New Pump Station	2	LS	$ 750,000	$1,500,000
4	Existing WWTP Demolition	1	LS	$ 1,100,000	$1,100,000
5	Biosolids Handling Facility	1	LS	$ 2,017,925	$2,017,925
6	Railroad Crossing	2	EA	$ 60,000	$120,000
				Subtotal	**$ 12,119,175**
			Contingency	30%	$ 3,635,753
			Sales Tax	8.8%	$ 1,066,487
			Planning Level Construction Cost		**$ 16,821,415**
			Administration, Legal	10%	$ 1,682,141
	Engineering/Permitting/Construction Management			35%	$ 5,887,495
				Subtotal	**$ 24,391,052**
7	Property Acquisition	1	LS	$ 125,000	$125,000
	Property Inflation at 10%	1	LS	$ 12,500	$12,500
	Administration, Legal at 10%	1	LS	$ 12,500	$12,500
				Subtotal	**$ 150,000**
				PROJECT TOTAL:	**$ 24,541,052**

NOTES/ASSUMPTIONS:
Contractor installation, overhead and profit already included in construction costs

City of Montesano
Planning-Level Engineers Opinion of Probable Construction Cost
WWTP Relocation Conceptual Evaluation

Alternative 3A: MBR at Near Location
Prepared by: B. Moss

Item Number	Description	Quantity	Unit	Unit Price	Total
1	New WWTP	1	LS	$ 9,200,000	$9,200,000
2	New Influent/Effluent Pipes	200	FT	$ 375	$75,000
3	New Pump Station	1	LS	$ 750,000	$750,000
4	Existing WWTP Demolition	1	LS	$ 1,100,000	$1,100,000
5	Biosolids Handling Facility	1	LS	$ 2,017,925	$2,017,925
				Subtotal	**$ 13,142,925**
			Contingency	30%	$ 3,942,878
			Sales Tax	8.8%	$ 1,156,577
			Planning Level Construction Cost		**$ 18,242,380**
			Administration, Legal	10%	$ 1,824,238
	Engineering/Permitting/Construction Management			35%	$ 6,384,833
				Subtotal	**$ 26,451,451**
6	Property Acquisition	1	LS	$ 125,000	$125,000
	Property Inflation at 10%	1	LS	$ 12,500	$12,500
	Administration, Legal at 10%	1	LS	$ 12,500	$12,500
				Subtotal	**$ 150,000**
				PROJECT TOTAL:	**$ 26,601,451**

NOTES/ASSUMPTIONS:
Contractor installation, overhead and profit already included in construction costs

City of Montesano
Planning-Level Engineers Opinion of Probable Construction Cost
WWTP Relocation Conceptual Evaluation

Alternative 3B: MBR at Middle Location
Prepared by: B. Moss

Item Number	Description	Quantity	Unit	Unit Price	Total
1	New WWTP	1	LS	$ 9,200,000	$9,200,000
2	New Influent/Effluent Pipes	1,350	FT	$ 375	$506,250
3	New Pump Station	2	LS	$ 750,000	$1,500,000
4	Existing WWTP Demolition	1	LS	$ 1,100,000	$1,100,000
5	Biosolids Handling Facility	1	LS	$ 2,017,925	$2,017,925
6	Railroad Crossing	2	EA	$ 60,000	$120,000
				Subtotal	**$ 14,444,175**
			Contingency	30%	$ 4,333,253
			Sales Tax	8.8%	$ 1,271,087
			Planning Level Construction Cost		**$ 20,048,515**
			Administration, Legal	10%	$ 2,004,851
	Engineering/Permitting/Construction Management			35%	$ 7,016,980
				Subtotal	**$ 29,070,347**
7	Property Acquisition	1	LS	$ 125,000	$125,000
	Property Inflation at 10%	1	LS	$ 12,500	$12,500
	Administration, Legal at 10%	1	LS	$ 12,500	$12,500
				Subtotal	**$ 150,000**
				PROJECT TOTAL:	**$ 29,220,347**

NOTES/ASSUMPTIONS:
Contractor installation, overhead and profit already included in construction costs

City of Montesano
Planning-Level Engineers Opinion of Probable Construction Cost
WWTP Relocation Conceptual Evaluation

Alternative 3C: MBR at Far Location
Prepared by: B. Moss

Item Number	Description	Quantity	Unit	Unit Price	Total
1	New WWTP	1	LS	$ 9,200,000	$9,200,000
2	New Influent/Effluent Pipes	3,150	FT	$ 375	$1,181,250
3	New Pump Station	2	LS	$ 750,000	$1,500,000
4	Existing WWTP Demolition	1	LS	$ 1,100,000	$1,100,000
5	Biosolids Handling Facility	1	LS	$ 2,017,925	$2,017,925
6	Railroad Crossing	2	EA	$ 60,000	$120,000
				Subtotal	**$ 15,119,175**
			Contingency	30%	$ 4,535,753
			Sales Tax	8.8%	$ 1,330,487
			Planning Level Construction Cost		**$ 20,985,415**
			Administration, Legal	10%	$ 2,098,541
	Engineering/Permitting/Construction Management			35%	$ 7,344,895
				Subtotal	**$ 30,428,852**
7	Property Acquisition	1	LS	$ 125,000	$125,000
	Property Inflation at 10%	1	LS	$ 12,500	$12,500
	Administration, Legal at 10%	1	LS	$ 12,500	$12,500
				Subtotal	**$ 150,000**
				PROJECT TOTAL:	**$ 30,578,852**

NOTES/ASSUMPTIONS:
Contractor installation, overhead and profit already included in construction costs

City of Montesano
Planning-Level Engineers Opinion of Probable Construction Cost
WWTP Biosolids Handling Facility

Alternative: Biosolids Dewatering with Screw Press
Prepared by: B. Moss

Item Number	Description	Quantity	Unit	Unit Price	Total
1	Screw Press System (includes polymer system, pumps, floc mixing tank)	1	LS	$ 375,000	$ 375,000
2	Conveyor	1	LS	$ 25,000	$ 25,000
3	Solids Handling Building (60'x34')	1	LS	$ 408,000	$ 408,000
4	Grubbing, Demo, Earthwork, Fill, Grading, Potential Dewatering for Building Construction	1	LS	$ 30,000	$ 30,000
5	Roadway Improvements around Building	1	LS	$ 20,000	$ 20,000
6	Solids Holding Tank in Building: Possible Shoring, Pumps, Piping, Valves, Aeration	1	LS	$ 75,000	$ 75,000
7	Handrails, Walkways, Stairs in Building	1	LS	$ 25,000	$ 25,000
8	Odor Control (carbon scrubbers)	1	LS	$ 100,000	$ 100,000
9	Enclosed Area for Truck (12'x35')	1	LS	$ 58,800	$ 58,800
10	HVAC	1	LS	$ 25,000	$ 25,000
11	Sludge Pump Piping	1	LS	$ 25,000	$ 25,000
12	Builidng Drains, Water, and Piping	1	LS	$ 25,000	$ 25,000
13	Yard Piping (wasted biosolids to facility, decant to headworks)	1	LS	$ 50,000	$ 50,000
14	Electrical & Controls (@30% total cost)	1	LS	$ 372,540	$ 372,540
			Contractor Installation	10%	$ 161,434
			Mobilization	5%	$ 80,717
			Contractor Overhead and Profit	10%	$ 161,434
				Subtotal	**$ 2,017,925**
			Contingency	30%	$ 605,378
			Sales Tax	8.8%	$ 177,577
				Planning Level Construction Cost	**$ 2,800,880**
			Administration, Legal	10%	$ 280,088
			Engineering/Permitting/Construction Management	35%	$ 980,308
				PROJECT TOTAL:	**$ 4,061,276**

NOTES/ASSUMPTIONS:

Montesano WWTP River Migration Protection and Habitat Restoration Program

By Matt Kastberg / Parametrix / June 28th, 2017

Phase 1: Sheet Pile Wall - upland 300' long 50' deep sheet pile wall to north			
Task 1: Project Management and Coordination	$	10,000	10% of Task 2
Task 2: Design, Permitting and Bid Support	$	100,000	conservative estimate
Task 3: Construction 300lf Sheet Pile Wall	$	3,000,000	$1000/lf installed
Task 4: Construction Engineer Log Jams along face Sheet Pile Wall	$	600,000	Rough conservative estimate
Task 5: Construction Staging, Mobilization, Mitigation, etc.	$	300,000	Rough conservative estimate
Task 6: Construction Management and Contract Administration	$	390,000	10% of Construction Cost (Tasks 3-5)
Subtotal	$	4,400,000	
15% Contingency	$	585,000	15% of Construction Cost (Task 3-5)
Phase 1 Subtotal	**$**	**4,985,000**	

City of Montesano
Planning-Level Engineers Opinion of Probable Construction Cost
WWTP UV Disinfection System

Alternative: Primary Disinfection using UV Light Radiation
Prepared by: B. Moss

Item Number	Description	Quantity	Unit	Unit Price	Total
1	UV Light Reactor for Primary Disinfection (includes power panel, hmi panel, spare parts)	1	LS	$ 415,000	$ 415,000
2	Chlorine Contact Basin Structural Modifications	1	LS	$ 75,000	$ 75,000
3	Start-up and commissioning	1	LS	$ 10,000	$ 10,000
4	Electrical & Controls (@20% total cost)	1	LS	$ 100,000	$ 100,000
			Contractor Installation	10%	$ 50,000
			Mobilization	5%	$ 25,000
			Contractor Overhead and Profit	10%	$ 50,000
				Subtotal	**$ 725,000**
			Contingency	30%	$ 217,500
			Sales Tax	8.8%	$ 63,800
				Planning Level Construction Cost	**$ 1,006,300**
			Administration, Legal	10%	$ 100,630
			Engineering/Permitting/Construction Management	35%	$ 352,205
				PROJECT TOTAL:	**$ 1,459,135**

NOTES/ASSUMPTIONS:

Appendix B

Supporting Documents Including Engineer's Opinion of Probable Construction Costs, Quantity Takeoffs

Lagoon Construction Cost Estimate

Montesano Design Flow 350000 gal/day

*assumed 3% inflation each year

Moses Lake Biolac® Wave Oxidation System

Two basins, Three clarifiers

Headworks screens, floating aeration chains, air control valves, blowers, DO system, PLC controls, biosolids lagoon

	Project Cost	$	7,000,000		
	Flow		750000	gal/day	(0.75 MGD)
		$	9.33	$/gal 2005	
		$	12.69	$/gal	Inflated to 2017 dollar using 3% inflation per year
		$	4,442,667		
1	Montesano Forecast	$	4,400,000	*round to nearest hundred thousand	

Laurel, Delaware

Biolac® + DynaSand® Filtration, includes biosolids lagoon

	Project Cost	$	11.43	$/gal 2009	
	Flow		700000	gal/day	(0.7 MGD)
		$	8,001,000	total $	
		$	14.17	$/gal	Inflated to 2017 dollar using 3% inflation per year
		$	4,960,620		
2	Montesano Forecast	$	5,000,000	*round to nearest hundred thousand	

Aerated Lagoon Pond (EPA 2011 report)

	Construction Cost	$	2,712,276	Equation from Figure 8-4, cost in 2006 $, for 670,000 gpd system	
		$	3,607,327	total $	Inflated to 2017 dollar using 3% inflation per year
3	Montesano Forecast	$	3,600,000	*round to nearest hundred thousand	

Range	Min	Max
	$ 3,600,000	$ 5,000,000

Average Cost	$ 4,300,000	*round to nearest hundred thousand

(from lines 1, 2, 3)

SBR Construction Cost Estimate

Montesano
Flow (gpd) 350000

	Cheyney University WWTP, Cheyney, Pennsylvania			*includes post eq tank, sludge digester, cloth disk filters, UV disinfection, sludge hauling
	0.36 MGD	$	5,300,000	total cost
		$	14.72	$/gal in 2013
		$	16.49	$/gal in 2017, assumes 3% inflation each year
		$	5,771,111	potential montesano cost, does not include engineering, inspection, or construction management
1	Montesano Forecast	$	5,800,000	*round to nearest hundred thousand
	Parametrix - Pacific City SBR			
	0.32 MGD			Includes filtration and disinfection
	Engineer Est.	$	5,900,000	removed cost of digester & shop construction facility, no headworks
		$	18.44	$/gal
2	Montesano Forecast	$	6,500,000	*round to nearest hundred thousand

Range		Min		Max
	$	5,800,000	$	6,500,000

Average Cost	$	6,200,000	*round to nearest hundred thousand
(from lines 1 & 2)			

MBR Construction Cost Estimate

Plant Size- Average Daily Flow (gpd)	5,000	30,000	200,000	500,000	1,000,000
Population	25	150	500	2500	5000
System Total Capital Cost Range (millions $)			3.18 - 5.42*	5.72 - 7.56*	9.79 - 11.79*
System Total Capital Cost Range ($ / gal)			15.90 - 27.10	11.44 - 15.21	9.79 - 11.79
Plant Size- Average Daily Flow (gpd)	2,000,000	3,000,000	4,000,000	5,000,000	10,000,000
Population	10000	15000	20000	25000	50000
System Total Capital Cost Range (millions $)				39.31 - 40.97*	72.01 - 78.77*
System Total Capital Cost Range ($ / gal)				7.86 - 8.19	7.20 - 7.88

Table Assumptions:

* - Design Criteria and Capital Costs per 2004 Desalination and Water Purification Research and Development Report No. 103: Optimization of Various MBR Systems for Water Reclamation - Phase III. Capital Costs updated to 2010 dollars (to account for future construction costs using 4 percent inflation rate per year. Capital costs include Land, Contingency and Legal/Admin/Engineering Costs. Cost Range is due to pricing differences in MBR equipment among 4 different manufacturers. Major Capital Cost items include Headworks, Process Basins, MBR System, Mechanical, Blower and Pump Building and Chlorine Dosing System. Odor Control and Waste Sludge Handling costs not included.

Using Cost Eval above , for 350,000 MGD use AVG of $15.21 and $27.10

		$ 21.16	$/gal 2010	
		$ 25.60	$/gal 2017	assumed 3% inflation each year
		$ 8,959,143	Forecasted Montesano cost @ 0.35 MGD, 2017 $	
		$ 5,429,783	subtract contingency (30%), legal/admin/engineering (35%)	
1	Montesano Forecast	$ 5,400,000	*round to nearest hundred thousand	

Cowlitz MBR (from 2015 feasibility TechMemo) ~0.5 MGD

MBR Equip Supply & Install	$	1,150,000
Water Reclamation Facility	$	9,305,000
Site civil	$	188,700
Electrical	$	142,000
6% inflation to 2017	$	647,142
Total	$	11,432,842
Total -MBR	$	10,213,842

subtract membrane price - re-adjust price below

Capacity (MMDF)		390000	gallons
	$	3.13	$/gal MBR only, 2017 dollars
Montesano (MMDF)		350000	gallons
Base Plant Fee	$	10,826,673	same as Cowlitz, 2017 dollars
MBR Cost	$	1,093,974	2017 dollars

2	Montesano Forecast	$	11,920,647	$ 11,900,000 *round to nearest hundred thousand

Discussion with Randy Raymond: Nisqually ~14M total w/ construction, engineering, management. ~0.4 MGD plant

3	Montesano Forecast	$	14,000,000	$ 10,400,000 cost minus engineering & management (35%), round to nearest hundred thousand

Range	Min	Max	
	$ 5,400,000	$ 11,900,000	*Round to nearest hundred thousand

Average Cost	$	9,200,000	*Round to nearest hundred thousand

(from lines 1, 2, 3)

Biosolids Facility Estimated O&M

Avg Daily Flow (gpd)	WAS produced (dry ton)	Septage Produced (dry tons)	Untreated Thickened WAS Disposal	Polymer for Thickening	Labor	Electrical	Small Repair	Utilities	Contingency	Annual Total
350,000	52	25	$ 76,700	$ 3,900	$ 25,000	$ 11,900	$ 7,700	$ 2,000	$ 9,700	$ 136,900

Notes:

From Yelm Facility Plan

$25k for labor as recommended by Mike Olden, City of Montesano

Existing WWTP Demolition Cost Estimate for Alterantives 1A-3C

Item	CostWorks Line Number	Quantity	Unit	Unit Cost	Total	Comment
Sludge Dewatering - Geotubes®	n/a	7494	CY	$ 6.65	$ 99,664	Assume 3' sludge depth in Pond #2. Assume total x2 for labor, overhead, profit
Dump Truck, 18 CY/25 ton, 4 axle	15433205310	7	Each/Day	$ 1,150.60	$ 8,054	Assume 4 round trips to landfill each day per truck (includes filling truck, 1hr round trip to landfill, and dumping truck). Requires 27 truck loads, see "Sludge Calc" sheet. Cost includes O&P.
Sludge Transport	28120101270	1064	Mile	$ 7.45	$ 7,927	Assume 38 mile round trip, 4 trips a day with 7 trucks. Cost includes O&P
Sludge Disposal	n/a	1071	CY	$ 8.00	$ 8,564	Stafford Creek Landfill (Aberdeen), $8/CY of dirt
Fence Removal	24113601700	1503	LF	$ 4.89	$ 7,350	Cost includes O&P
Building Demolition	24116130700	30464	CF	$ 2.91	$ 88,649	Includes Facilities Bldg, Blower Bldg. Cost includes O&P
Building Material Disposal	24116174250	1128	CY	$ 20.50	$ 23,130	for transpo. up to 5 miles (true cost may be slightly more b/c landfill is 19 miles away), includes O&P cost
Polish. Pond Bldg. Lumber	24210101100	4.1	MBF	$ (55.00)	$ (227)	Value shown as negative indicates salvage value return
Crushed stone fill, 1/2"	310513100340	2781	LCY	$ 38.00	$ 105,678	Includes crew, equip, O&P, no compaction, For filling Pond #1, #2, anoxic basins, clarifiers
Bank sand fill	310516100500	22058	LCY	$ 27.50	$ 606,595	Includes crew, equip, O&P, no compaction, For filling Pond #1, #2, anoxic basins, clarifiers
Remove Mechanical Equips	n/a	1.0	LS	$ 100,000	$ 100,000	See "Mechanical Equip" below
				Subtotal	$ 1,100,000	*round up to nearest hundred thousand
				Tax (8.8%)	$ 97,000	*round up to nearest thousand
				Contingency (30%)	$ 330,000	
				Total	$ 1,500,000	*round up to nearest hundred thousand
				Admin, Legal (10%)	$ 150,000	
				Engineering/Permitting/Management (35%)	$ 500,000	*round up to nearest hundred thousand
				Grand Total	$ 2,200,000	*round up to nearest hundred thousand

Mechanical Equip:
4 anoxic selector mixers
2 clarifier mechanisms, 2 scum skimmers, 2 walkways
2 lime slurry pumps + ~1000 gal tank
ras/was pump station, 2 pumps
drain pump station, 1 pump
on-site pump station, 2 pumps
aeration, 3 blowers
chlorine contact basin, 2 pumps
Lagoon aerators, 8 lines each with 10 biodiffuers

Existing WWTP Demolition Cost Estimate for Alterantives 4A and 4B

Item	CostWorks Line Number	Quantity	Unit	Unit Cost	Total	Comment
Sludge Dewatering - Geotubes®	n/a	7494	CY	$ 6.65	$ 99,664	Assume 3' sludge depth in Pond #2. Assume total x2 for labor, overhead, profit
Dump Truck, 18 CY/25 ton, 4 axle	15433205310	7	Each/Day	$ 1,150.60	$ 8,054	Assume 4 round trips to landfill each day per truck (includes filling truck, 1hr round trip to landfill, and dumping truck). Requires 27 truck loads, see "Sludge Calc" sheet. Cost includes O&P.
Sludge Transport	28120101270	1064	Mile	$ 7.45	$ 7,927	Assume 38 mile round trip, 4 trips a day with 7 trucks. Cost includes O&P
Sludge Disposal	n/a	1071	CY	$ 8.00	$ 8,564	Stafford Creek Landfill (Aberdeen), $8/CY of dirt
Crushed stone fill, 1/2"	310513100340	2131	LCY	$ 38.00	$ 80,978	Includes crew, equip, O&P, no compaction, For filling Pond #1, #2, anoxic basins, clarifiers
Bank sand fill	310516100500	14437	LCY	$ 27.50	$ 397,018	Includes crew, equip, O&P, no compaction, For filling Pond #1, #2, anoxic basins, clarifiers
				Subtotal	$ 600,000	*round up to nearest hundred thousand
				Tax (8.8%)	$ 53,000	*round up to nearest thousand
				Contingency (30%)	$ 180,000	
				Total	$ 800,000	*round up to nearest hundred thousand
				Admin, Legal (10%)	$ 80,000	
				Engineering/Permitting/Management (35%)	$ 300,000	*round up to nearest hundred thousand
				Grand Total	$ 1,200,000	*round up to nearest hundred thousand

Pipe Construction Cost Estimate

Assumed 15" pressure pipe @ $375 per foot (includes to and from plant), construction cost only

Assumed pipe was consructed entirely in existing right-of-way

Near Site (~200 ft away from PSV/influent pipe)

Pipe distance required		200	ft
Cost/ft	$	375	
Total	$	75,000	

Middle Site (~700 ft away from PSV/influent pipe)

Pipe distance required		1350	ft
Cost/ft	$	375	
Total	$	506,250	

Far Site (~2600 ft away from PSV/influent pipe)

Pipe distance required		3150	ft
Cost/ft	$	375	
Total	$	1,181,250	

Sludge Volume Calculation for Demolition

Lagoon Parameters			
Bottom Length	265	ft	
Bottom Width	100	ft	
Height	11	ft	
Side Slope width	33	ft	(3:1 side slope)
Assumed Sludge Depth	6	ft	
Lagoon Total Volume	291500	CF	
Inner Sludge Vol	159000	CF	(area of bottom sludge depth - rectangular volume)
length of sludge on slope	18	ft	(find x width of sludge 'triangle')
Slope Sludge Vol	43308	CF	(find area of 'triangle', multiple by slope perimeter at top of sludge depth)
Total Sludge Vol	202326	CF	
	7494	CY	

For approximate calculations of dewatered solids, volume vairies inversely with the percent solid matter in the sludge (Metcalf & Eddy, 5th Ed.)

V1/V2=P2/P1, where V=volume and P=% solids

V1	202326	CF	
P1	5	assume lagoon sludge @ 5% solids	
P2	35	assume dewatered sludge @ 35% solids	
V2 =	28904	CF	
	1071	CY	(at 18 CY per truck = 27 truck loads, this is limiting factor for transport)
Sg	1.3	assumed specific gravity of solids (Metcalf & Eddy 5th Ed.)	
density of water	62.4	lb/cf	
density of dewatered sludge	81.12	lb/cf	
Weight of dewatered sludge	2344669.3	lb	
	1172.3	TON	(at 25 tons per truck = 21 truck loads)

Quantity Takeoffs for WWTP Demolition Cost Estimate

Blower Building

L	37	ft	
W	18.33333	ft	
H	10	ft	
Roof H	5	ft	
Total	8479	CF	includes roof

Control Building

	Small bldg	Carport	Large bldg	
L	21.5	29	29	ft
W	9	18	26	ft
H	8	10	8	ft
Total	1548	5220	6032	CF

Control Building Roof

L	13	18	30	ft
W	37	25		ft
H	9			ft
Total	9185	CF		

Polish Pond Structure Wood Beam Salvage

Beam Foot Total	4122	BF
	4.12	MBF

"corners"

3	ft	2x6	
6	ft	2x6	
8.5	ft	2x8	
11	ft	2x10	
13	ft	2x10	x5
4	ft	2x6	
6.5	ft	2x6	
9	ft	2x8	
11.5	ft	2x10	

totals			
2x6	19.5	ft	
2x8	17.5	ft	
2x10	76.5	ft	

Approx. 8 identical sections

156	ft	117
140	ft	140
612	ft	765

Equiv BF

"middle"

2x10	25	x19
2x8	7.5	x2
2x8	5	
5-1/8x12	20	x2
5-1/8x24	32	

Approx. 2 identical areas

		Equiv BF
2x10	950	1187.5
2x8	40	40
5-1/8x12	80	400
5-1/8x24	64	640

"center beam"

47	ft	6+3/4 x 31+1/2

Equiv BF

833

Fill for Pond #1			Fill for Pond #1		
For 2 foot of 1/2" crushed stone on bottom			For remaining with sand		
Bottom Length	75	ft	Bottom Length	100	ft
Bottom Width	75	ft	Bottom Width	100	ft
Height	11	ft	Height	11	ft
Side Slope width	33	ft	Side Slope width	33	ft
Depth	2	ft	Depth	9	ft
Inner Vol	11250	CF	Inner Vol	90000	CF
length of fill on slope	6	ft	Slope Vol	93366	CF
Slope Vol	2244	CF			
Total Vol	13500	CF	Total Vol	183366	CF
	500	CY		6792	CY

Fill for Pond #2			Fill for Pond #2		
For 2 foot of 1/2" crushed stone on bottom			For remaining with sand		
Bottom Length	265	ft	Bottom Length	265	ft
Bottom Width	100	ft	Bottom Width	100	ft
Height	11	ft	Height	11	ft
Side Slope width	33	ft	Side Slope width	33	ft
Depth	2	ft	Depth	9	ft
Inner Vol	53000	CF	Inner Vol	238500	CF
length of fill on slope	6	ft	Slope Vol	151281	CF
Slope Vol	4524	CF			
Total Vol	57530	CF	Total Vol	389781	CF
	2131	CY		14437	CY

Fill for Anoxic Selector Basins			Fill for Anoxic Selector Basins		
Fill with 2' stone			Fill remaining with sand		
Length	56.33333	ft	Length	56.33333	ft
Width	13.33333	ft	Width	13.33333	ft
Depth	2	ft	Depth	8	ft
Volume	1502.222	CF	Volume	6008.889	CF
	56	CY		223	CY

Fill for Clarifiers			Fill for Clarifiers		
Fill with 2' stone			Fill remaining with sand		
Diameter	40	ft	Diameter	40	ft
Depth	2	ft	Depth	13	ft
Volume	2513.274	CF	Volume	16336.28	CF
	94	CY		606	CY