

## APPENDIX 6A

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### COST CRITERIA

#### 6A.1 Cost Criteria

Cost criteria include capital and operating costs as well as other resource factors such as energy, chemical and materials use, and staffing. Monetary cost criteria can be aggregated by calculation of total annual costs or present worth.

##### 6A.1.1 Basis of Cost Estimates

Construction and O&M costs cited in this report are based on preliminary layouts of the proposed alternatives. In considering the estimates, it is important to realize that changes during final design and future changes in the cost of materials, labor, and equipment will cause changes in costs provided herein. However, because the relative economy of alternative projects can be expected to change only slightly with respect to each other, decisions based on present comparison should remain valid.

##### 6A.1.2 Precision of Cost Estimates and Construction Contingency

Cost estimating is an evaluation of the cost of all elements of a well-defined project. The planning-level cost estimate approach will be used for this Facility Plan. This estimate, also referred to as an “order of magnitude” estimate, is made without detailed engineering data. It may use cost capacity curves, scale-up/scale-down factors, and/or approximate ratio relationships. The range of accuracy normally associated with this estimate is from +50 percent to -30 percent. It is this level of estimating accuracy that will be applied to this Facility Plan.

The degree of accuracy should not be confused with the contingency applied to the project. The range of accuracy reflects the cost estimating method used as well as the amount of detail available.

The contingency is an allowance for undefined items. This allowance covers items of work that will have to be performed, or other elements of cost that will be incurred, that were not explicitly foreseen at the time of the estimate because of lack of complete, accurate, and detailed information.

The contingency is not intended to cover some potential additions to the scope of the work, nor any act of nature, unusual economic situations, or strikes, or to compensate for any inaccuracy of the estimate. Because the contingency is required to cover costs that are almost certain to be incurred, it is an integral part of the estimate. Construction contingencies used in this project are discussed below in more detail. The degree of accuracy applies to the total construction cost, which includes the construction contingency. Costs are escalated to the midpoint of construction. Using this approach, an additional uniform contingency of 35 percent is applied to all types of construction projects.

The costs provided in the recommendations chapters reflect the probable range of cost and the “most probable” cost. The most probable cost is used in the final chapters to discuss the rate impacts of the recommended improvements.

### 6A.1.3 Total Project Costs (Capital Costs)

The total project cost, or capital cost, of future facilities includes the estimated total construction cost (which includes an allowance to cover contingencies, plus Washington State sales tax, administrative, engineering, financial and legal costs). The assumptions for these allowances are presented below.

#### 6A.1.3.1 Construction Cost

The construction cost estimate consists of costs that the contractor is expected to charge the County for building the future facilities. The construction cost includes the cost of the labor, materials, equipment, subcontractors, mobilization, overhead and profit, contingencies, and Washington State sales tax. This value represents a construction contractor's cost including construction bids and any subsequent change orders.

#### 6A.1.3.2 Cost Index

Construction costs can be expected to undergo long-term changes in keeping with corresponding changes in the national and local economy. One of the most common, available indices of these changes has been the Engineering News Record Construction Cost Index (ENR-CCI), which is computed from prices of construction materials and labor and is based on a value of 100 in the year 1913. It is believed that the ENR-CCI in the Seattle area is representative of the construction cost in Kitsap County. The costs presented for the recommended facilities are based on February 2009 dollars. The Seattle ENR-CCI for February 2009 is 8713. Costs used in the Facility Plan have been projected based on an average inflation rate of 4 percent.

#### 6A.1.3.3 Sales Tax

Total construction costs also include the Washington State sales tax the contractor would charge. A sales tax rate of 8.6 percent has been used.

#### 6A.1.3.4 Administrative, Engineering, Financial, and Legal Costs

Cost of engineering services may include special investigations, surveys, foundation explorations, location of interfering utilities, detailed design, preparation of contract drawings and specifications, general construction assistance, detailed onsite construction inspection, materials testing, final inspection of the completed work, pumping station startup services, operator training, and preparation of as-built drawings. Total engineering costs for design and construction assistance can vary from 12 to 30 percent of the total construction cost, depending on the complexity of the project. The lower percentage applies to projects relatively simple or repetitive in nature. The higher percentage applies to projects that require a great deal of preliminary investigation work, require substantial permitting, or involve considerable remodel work to existing facilities.

Other costs directly associated with the cost of constructing facilities include administrative, financial, and legal services; costs associated with bond sales; and interest on money borrowed during the construction period. Administrative and legal proceedings could represent a significant expenditure for the formation of special utility districts, for preparation of inter-agency agreements, and for O&M contracts. Based on experience, allowances for administrative, financial, and legal costs have varied from 5 to 10 percent of total construction costs.

This report utilizes a combined approximate cost for administrative, engineering, financial, and legal services of 30 percent of the total construction cost (base construction cost plus contingency and sales tax).

### 6A.1.3.5 Summary of Total Project Cost Elements

The total project costs, or the capital-cost estimates, are based on the sequential application of the cost factors shown in Table 6-1.

Item	Percent
Construction cost plus escalation	100
Contingency	35
Washington State sales tax	8.6
Engineering, legal, and administrative	30

*a. Factors are applied sequentially [i.e. Total Project Cost = Construction Cost x (1 + 0.35 + (1 + 0.35) x 0.086 + ((1 + 0.35) x 0.086) x 0.30 = Construction Cost x 1.905]*

### 6A.1.4 Operation-and-Maintenance Costs

Operation and maintenance includes all costs for labor, materials and supplies, energy, and chemicals related to each major system component and an allowance for major equipment repair. For cost analysis purposes, the annual O&M costs are based on the projected flows and loadings for the midpoint of the planning period. Costs are inflated at 4 percent to this point, then converted back to present worth using the EPA discount rate. The present-worth time frame is identified in each cost table. A 35 percent contingency allowance is applied to account for uncertainties in the project costs of labor, materials and supplies, energy, and chemicals.

### 6A.1.5 Net Present Value Analysis

A net present value (NPV) analysis converts all future costs and credits into present-day dollars and then adds them to the initial capital costs to compare alternatives. Table 6-2 summarizes the net present value criteria used in the Facility Plan.

Item	Planning criteria
Basis for cost projections	
Year	February 2009
ENR-CCI Index (Seattle)	8713
Inflation rates	
Construction	4 percent
Energy	4 percent
O&M	4 percent
Land appreciation	4 percent
Discount rate	6 percent

Table 6-2. Summary of Net Present Value (NPV) Criteria	
Item	Planning criteria
Useful life (years)	
Land	Permanent
Sewers and pipelines	50 years
Treatment plant, pump station, or storage structures	50 years
Process equipment	20 years
Transportation equipment	10 years
Energy purchase	
Electricity	\$0.068/kw-hr
Labor rate	\$40/hr

## Appendix 6B

### Central Kitsap WW Facility Plan Alternative Initial Evaluation Criteria

This list of alternative initial evaluation criteria is to be used to perform the first round of evaluations for a broad array of treatment technologies at the CKWWTP. These criteria are used as pass/fail filters to eliminate those process technologies that do not meet basic CKWWTP project requirements. In recognition that a specific technology may not meet all of the Alternative Initial Evaluation Criteria, but may provide substantial benefit, a “wildcard” nomination is allowed to pass a technology that would have otherwise been eliminated. Those technologies meeting the requirements of all initial evaluation criteria, plus any “wildcard” nominations, make up the shortlist of alternatives for final evaluation.

First Round Initial Evaluation Criteria	Description
<b>Site Size:</b> Alternative fits within the footprint boundaries of current available space at the CKWWTP site, including space for future expansion and required buffer area.	Current site has been laid out for a nominal expansion of the primary and secondary treatment systems. This criterion is based on fitting the alternative facilities in the space remaining at the CKWWTP, including leaving the existing 100-foot buffer around the plant. Large-scale demolition of existing processes merely to create additional site space will not be considered unless there is overwhelming evidence of significant economic benefit to Kitsap County.
<b>Constructibility:</b> Alternative can be constructed without major disruptions resulting in permit violations, reduction in level of service, etc., to operations at the CKWWTP.	Alternatives must be selected that can be constructed without long-term disruptions to plant operations. Alternatives will be evaluated for the practicality of installation of bypasses or other approaches to enable construction while the existing plant continues to treat influent wastewater.
<b>Proven Technology:</b> Alternative is currently reliably operated in at least two 10-mgd or greater wastewater treatment plants for a period of at least 2 years without substantial manufacturer operations assistance.	Scaling up from pilot or small plant scale operations to large plant scale operation has inherent high risk. Many alternatives do not scale up well, resulting in everything from plaguing equipment and system operation and maintenance problems to complete process failure at full scale. Processes must be evaluated on their ability to obtain state and federal approval/certification for the duties intended.
<b>Ease of Operations:</b> Alternative is relatively simple to operate and maintain within training skills of the present plant staff.	Process alternatives vary in their complexity to operate and the number of and responsiveness to required process control actions. System complexity affects the staffing requirements and training necessary to maintain steady-state or stable operation.
<b>Process Standardization:</b> Alternative is either a process currently successfully operated by Kitsap County or offers a proven benefit over existing Kitsap County processes.	Many fringe technologies offer similar performance, cost, and other features as processes currently used by Kitsap County. An alternative to existing processes will be retained for further evaluation only if it offers a clear and proven benefit over the existing systems.

First Round Initial Evaluation Criteria	Description
<p><b>Current Technology:</b> Alternative is currently being applied in plants of 10 mgd or larger.</p>	<p>Many technologies were applied years to decades ago and since have failed to continue in development and application. Example technologies that meet the other screening criteria can be found, but which are considered by the industry as obsolete or clearly superior alternative technologies have since been developed. An example could be vacuum filters which have been virtually replaced in the industry by belt filter presses and centrifuges. These obsolete processes will be eliminated.</p>
<p><b>Previous Investigation:</b> Alternative has been studied by Kitsap County for a comparable situation within the last 10 years and found to offer advantages applicable to the CKWWTP.</p>	<p>Kitsap County has invested in limited efforts on a few projects to study, pilot test, and full scale test new technologies or facilities repair that can improve performance and cost. Some technologies have shown merit, but were not implemented. As examples, capital budget may not have been available, the process may not have been cost effective except in the case of greenfield development, etc. In these cases, if the alternative meets the other criteria and the CKWWTP situation is different and favorable for selection, the alternative will be retained for further development. If in the previous study the alternative was found by Kitsap County to not merit further development or application for reasons valid for CKWWTP, it will be eliminated from consideration.</p>
<p><b>Biosolids Use:</b> The alternative produces a Class A or B biosolids end product, stabilized to greater than 50 percent volatile solids reduction, and can be land applied or further processed for marketing consistent with or as an improvement to the existing biosolids use program.</p>	<p>The County wishes to continue with biosolids recycling and encourages finding ways to enhance product quality and make biosolids recycling more efficient. Alternatives that do not produce a higher quality product better or equal to existing biosolids product from the CKWWTP will be eliminated.</p>
<p><b>Reclaimed Water Use:</b> Alternative produces a Class A reclaimed water or better or at least does not preclude the ability at the CKWWTP from producing acceptable reclaimed water.</p>	<p>Kitsap County wishes to encourage the use of reclaimed water. It is likely that a majority of reclaimed water could be used for groundwater recharge or constructed wetland applications. As such, reclaimed water processes must be mindful of producing effluents that comply with current state guidance on total nitrogen total organic carbon, and other water quality criteria. Any process that precludes the production of reclaimed water for these purposes will be eliminated.</p>
<p><b>Odor Prevention:</b> The alternative's odors can be practically contained and treated to accepted CKWWTP goals. The alternative would not be the source of unusual or extreme odors that could be released and could not be practically contained or treated.</p>	<p>Some alternatives generate extreme odors that cannot always be contained and treated. Odor treatment and reliability is critical to the success of this program. Any alternative that does not lend itself to reliable control of odors will be eliminated.</p>
<p><b>Cost:</b> The alternative, after considering its impacts on and benefits to other plant processes, would have an order of magnitude life-cycle cost within an acceptable range of the alternative processes developed for the study.</p>	<p>Although no definitive cost estimate will be generated for the first-round screening, information may be available for comparable projects for which specific alternatives were evaluated against conventional technologies and found to be reasonably comparable in cost. Alternatively, they may have been found to be far more expensive. In such cases the alternative will be eliminated from further consideration.</p>

<b>First Round Initial Evaluation Criteria</b>	<b>Description</b>
<b>Sustainability:</b> The alternative uses (or produces) energy and chemicals at a rate typical of other Kitsap County facilities or better or offers other significant benefits that warrant its consideration.	A goal of the CKWWTP project is to create as sustainable a project as possible. To achieve the project's sustainability goals, the CKWWTP facilities must meet or exceed existing plant sustainability performance. Those alternatives that are clearly less sustainable from these perspectives without offering other significant benefits will be eliminated.
<b>Flexibility and Expandability:</b> Alternative can be adapted for changes in future regulatory requirements and can be expanded to accommodate growth.	Alternatives need to be flexible for logical expansion of facilities to accommodate growth and increasing loads. They also need to have inherent flexibility to successfully handle unforeseen process load conditions.
<b>Permitability:</b> Technology alternative is approvable by Ecology and other permitting agencies within limited time frame of this project.	Some alternatives may require considerable research, further study, pilot work, or field monitoring to convince Ecology of its acceptability. Processes that do not have a reasonable chance of achieving Ecology or other permitting agency approval within the required project schedule will be eliminated.
<b>Process Relevance:</b> The process alternative provides adequate treatment relative to all known and likely future relevant criteria affecting liquid stream or solids stream products.	Some alternatives may treat process streams with irrelevant criteria, not suitable for use at Kitsap County. For example, because the CKWWTP discharges to marine water, an effluent criterion for phosphorous control does not apply and treatment technologies designed to reduce effluent phosphorous are not relevant.
<b>Visual Aesthetics:</b> The alternative provides aesthetic/mitigation opportunities without extraordinary visual impacts.	The visual character of the CKWWTP will be a factor in the public support for the facility. Alternatives that have an extraordinary visual impact without the ability to be mitigated through architectural or landscape design will be eliminated. In addition alternatives that do not have a reasonable chance of being accepted by relevant permitting authorities within the time frame of this project due to these extraordinary visual impacts will be eliminated based on the permitability criterion.
<b>Kitsap County Policy Direction:</b> Alternative meets all Kitsap County policy directives.	Any alternative that does not meet current Kitsap County policy directives will be eliminated.

## Appendix 6C

### CKWWTP Facility Plan Final Evaluation Criteria for Process Selection

Once the short list of acceptable process alternatives was determined using the pass/fail initial evaluation criteria, detailed technical descriptions and cost evaluations of the alternatives are to be prepared. Cost evaluations are not the sole basis for selection. Typically, at least two alternatives end up being very close in cost and other technical factors dictate final process choice. Before selecting and developing the final alternatives, it is helpful to develop the technical criteria and process upon which they will be evaluated. This separation of the development of technical criteria, final evaluation process, and relative importance of each criterion from the actual analysis of alternatives enhances the objectivity of the evaluation. Final evaluation criteria were developed in six principal categories: Process Considerations, O&M Considerations, Flexibility for Future Expansion or Enhancement, Reuse/Energy Conservation/Biosolids Utilization/Sustainability, Environmental and Community Considerations, and Cost. The following criteria and rating system were developed prior to and used in the evaluation of alternative technologies:

#### **Process Considerations**

**Reliability.** The proven ability of the treatment process to consistently meet discharge requirements under conditions typically encountered in day-to-day operations. Among other issues, this may relate to vulnerability due to the requirement for chemicals with delivery constraints. The demonstration of this criterion shall be based on plant-scale experience at comparable flows and loads to those of the CKWWTP.

**Robustness.** The ability of the process or treatment scheme to operate and maintain operational compliance under the full range of unusual wastewater regimes such as slug or shock loads or seasonal peaks.

**Liquid stream/solids impacts.** Each liquid stream alternative would generate biological sludges in different quantities and having different thickening and dewatering properties. In addition, different sludge treatment systems have different recycle impacts on liquid stream processes. To a large extent, these impacts will be accounted for in the overall cost of the individual comprehensive alternative. This criterion rates only the impacts that cannot be accounted for directly in cost estimates, such as influence on process robustness, effluent impacts, etc.

**Process standardization.** There is an advantage in maintaining consistency in process and mechanical design at all Kitsap County plants. This permits the County to provide a resource base of O&M expertise and potentially spare parts that can serve all facilities more efficiently.

**Process flexibility.** The ability of the process to be easily modified or operated in another mode to meet changing regulatory requirements, growth in population and commercial

load, growth or changing character of industrial load, increasing needs for reclaimed water, or technology advances. For liquid processes this would include but not be limited to the ability to produce reclaimed water or be easily modified to do so or be easily modified to remove ammonia or other compounds of concern in the future. For sludge treatment this would include but not be limited to the ability to produce Class A biosolids or be easily modified to do so.

**Ease of construction.** This relates to potential impacts on operations when new or expanded facilities are built, including the risk of damage to existing structures; safety impacts; and interference with plant operations. This criterion is also used to assess the difficulty and impacts related to future construction under lids or structural enclosures constructed for co-use or mitigation purposes.

**Ease of odor containment.** Odor and air contaminant releases under normal and upset conditions will vary among the processes evaluated. This criterion rates the ease with which odors can be contained and treated.

### **O&M Considerations**

**Operator safety.** The ability of the process to operate under established procedures without posing a safety risk to the operation and maintenance staff. The potential hazards posed by any chemical used for the process may relate to the safety risk to operators. The use or generation of explosive or toxic gases is an additional safety consideration. Staff are well trained in required safety procedures. However, some exposure is unavoidable. This criterion is used to assess the level of exposure after control and safety measures are employed.

**Ease of maintenance.** Equipment or process units that are easier to maintain will result in less disruption of the plant by maintaining higher process unit availability and lower cost. Ease of maintenance is measured from the expected frequency of maintenance, the difficulty and hazards inherent in any maintenance event, ease of accessibility, the labor hours and parts required for a specific maintenance event, system interference during maintenance, and the requirement for specialized expertise.

**Ease of operation.** Process alternatives vary in their complexity to operate and the number of and responsiveness to required process control actions. System complexity affects the staffing requirements and training necessary to maintain steady-state or stable operation. This criterion also is used to assess the number of operator hours required and the ability to easily automate the process and the reliability of the automation system.

**Operating flexibility.** Operating flexibility relates to the ability to easily change process modes in response to changing daily or seasonal influent conditions or receiving water requirements.

**Operating environment.** The operating environment can pose varying degrees of nuisance to staff. Measures will be taken to control noise and odorous or hazardous gas releases and exposure to operation and maintenance staff. In addition, staff are well trained in required operating procedures. However, some exposure is unavoidable. This

criterion is used to assess the level of potential nuisance exposure to staff after control measures are employed. Safety aspects of exposure are rated under the operator safety criterion.

### **Flexibility for Future Expansion or Enhancement**

The ability of the treatment process to easily accommodate a future expansion to handle additional flows and loads or to be transformed by new technologies necessary to achieve new treatment goals driven by changing regulations, County policies, or other influences affecting treatment. This flexibility will be manifested in treatment processes and elements that can accommodate future changes without compromising plant operations or performance, and that also do not result in facilities that are shortsighted, leave stranded investments, or that place facilities in site locations that are inconvenient for future expansion or change.

### **Reuse and Biosolids Utilization**

This criterion is used to assess the relative benefits of the alternatives with respect to use of nonrenewable resources; use of recycled products; generation of beneficial products such as biogas, biosolids, and reclaimed water; and other benefits or impacts related to environmental sustainability. Chemical requirements vary for process operations. The extent to which these chemicals are “renewable” and require energy to produce and deliver also relates to the sustainability impacts of the alternative. The safety aspects of chemical use are rated under the safety criteria.

### **Energy Usage**

Various treatment processes have different energy requirements. Some processes such as anaerobic digestion are net energy producers. This criterion is used to assess the overall impacts of the alternatives with respect to the use and generation of energy.

### **Environmental and Community Considerations**

**Public safety and security.** After employing practical and reasonable control measures, the system will operate within acceptable public safety risk. This criterion rates the level of control measures required and the relative minor remaining risk. The potential hazards posed by any chemical used for the process relate to the safety risk to the public. The use or generation of explosive or toxic gases is an additional safety and security consideration.

**Effluent quality.** All alternatives will meet the required effluent permit limits. This criterion rates the relative quality of the effluent recognizing that some alternatives may produce effluent of better quality than required by the permitting agencies.

**Site utilization.** Future plant expansions beyond near-term flows must be accommodated on the site. Also, room for additional treatment processes for removal of ammonia or other constituents must be accommodated on the treatment plant site if future regulations

or permit requirements dictate. This criterion is also used to assess the compactness of the overall process footprint and its ability to accommodate larger buffer areas.

**Construction impacts.** This relates to potential impacts on the existing community when new or expanded facilities are built, including traffic, noise, and dust impacts.

**Operational impacts.** This criterion is used to assess the potential impacts during plant operation from odor, noise, visual appearance, and traffic on the surrounding community. Odor and air contaminant release from processes under normal and upset conditions will vary among the processes evaluated. This criterion rates the frequency and potential severity of the releases and the intensity and character of the released odor or air contaminant after practical containment and treatment measures are employed. The type of mechanical equipment and structures employed by each process differs in noise generation. The ability to contain and dampen noise, meeting community and code requirements, will be assessed. Some treatment processes emphasize aboveground structures while others are primarily below ground. The alternatives will vary in mass, height, and location of structures and in the presence of visible plumes or flares. This alternative is also used to assess the ability of the alternative to be visually mitigated through architectural and landscape designs. In addition, the relative nuisance posed to the public by traffic from the plant will be assessed for each alternative.

## **Cost**

**Capital Cost.** The capital costs of the alternatives are considered under this criterion, including the cost impact on other unit processes such as recycle streams and the cost to mitigate potential impacts.

**Operation and maintenance cost.** The relative life-cycle operation and maintenance cost of the alternatives are considered under this criterion, including the cost impact on other unit processes such as recycle streams and the cost to mitigate potential impacts.

Each criteria category will be discussed and a consensus sought within Kitsap County on the relative weighting of the importance of each category with respect to the other categories. Next, the relative importance of individual criteria will be assessed by assigning them a weight with a total of 20 within each category. Finally, each alternative will be assessed against each criterion and assigned a rating, allowing an overall alternative score to be calculated.