Appendix H

Triple-Bottom-Line Analysis – Screening of Final Alternatives

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Appendix H.1

Triple-Bottom-Line Analysis Technical Memorandum

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Technical Memorandum

Date: May 18, 2010

To: Karen Huber, Susan Kaufman-Una - King County

From: Edith Hadler, Dan Pecha - HDR

Subject: Approach to Triple Bottom Line Analysis

1.0 Purpose

The purpose of this memorandum is to describe Triple Bottom Line Analysis and to explain the Triple Bottom Line Analysis approach to be used for the King County 2012 Combined Sewer Overflow (CSO) Control Program Review. Triple Bottom Line Analysis will be used for the evaluation of King County alternatives and for comparing the King County alternatives with joint King County/Seattle Public Utilities alternatives.

2.0 Background

Triple Bottom Line Analysis is an economic analysis technique that evaluates the benefits, costs, and risks of three areas: 1) financial, 2) social, and 3) environmental. This technique provides an analytical and modeling framework to find the most economical balance between capital investments and operation and maintenance expenditures to minimize the life-cycle costs of any capital asset, while incorporating social and environmental aspects.

Triple Bottom Line Analysis promotes decision-making armed with relevant information from a variety of perspectives. Triple Bottom Line Analysis also provides the following aspects which are important for decision making:

- Involves collaborative, transparent, consensus-building process;
- Considers costs and benefits based on multiple criteria;
- Addresses multiple, conflicting objectives;
- Provides clear, defensible, well-documented results;
- Identifies key risks; and
- Incorporates uncertainty in costs and benefits.

For the financial aspect of Triple Bottom Line Analysis, the cost of each alternative is estimated based on conceptual design information. Typically, the costs are the present value of capital (i.e., construction), operations, maintenance, and equipment replacement costs.

For the social and environmental aspects of Triple Bottom Line Analysis, benefits are analyzed using a technique called “value modeling”. In value modeling, each alternative is evaluated for the extent it meets project criteria, and the criteria are weighted according to their relative importance in making the project decisions. Scoring and weighting are done collaboratively by the stakeholders of the project.

Environmental and social effects differ from financial effects, and are similar to one another, in several ways:

- **They reflect externalities.** Unlike direct project costs that are included as financial effects, both environmental and social effects often represent side effects of projects. In

some cases, there is a regulatory requirement to assume some responsibility and to design projects to reduce the scale of undesirable external effects; in many cases, however, this is not the case.

- Quantification and valuation issues loom large. Environmental and social effects are not generally traded in the market, which eliminates a ready source of valuation. Inclusion of these effects in a Triple Bottom Line evaluation requires special efforts to quantify and value them.
- Valuation is based on preferences and value judgments of humans. Some environmental and social effects are based on perceptions or preferences, which may not be quantified. The absence of markets creates additional vagueness and imprecision in attempting to measure them.

There is no hard and fast distinction between environmental and social effects.

3.0 Triple Bottom Line Analysis Steps

Triple Bottom Line Analysis can be outlined into the following steps:

- Develop Criteria
- Establish Criteria Weighting
- Develop Alternatives
- Produce Cost Estimates
- Evaluate Alternatives
- Perform Value Modeling
- Identify Risks
- Perform Risk Analysis
- Review Results and Identify Preferred Alternatives

Figure 1 displays Triple Bottom Line Analysis steps in a flowchart, as presented at the King County 2012 CSO Control Program Review Kickoff Meeting on March 22, 2010. Each step is described in subsequent sections of this memorandum.

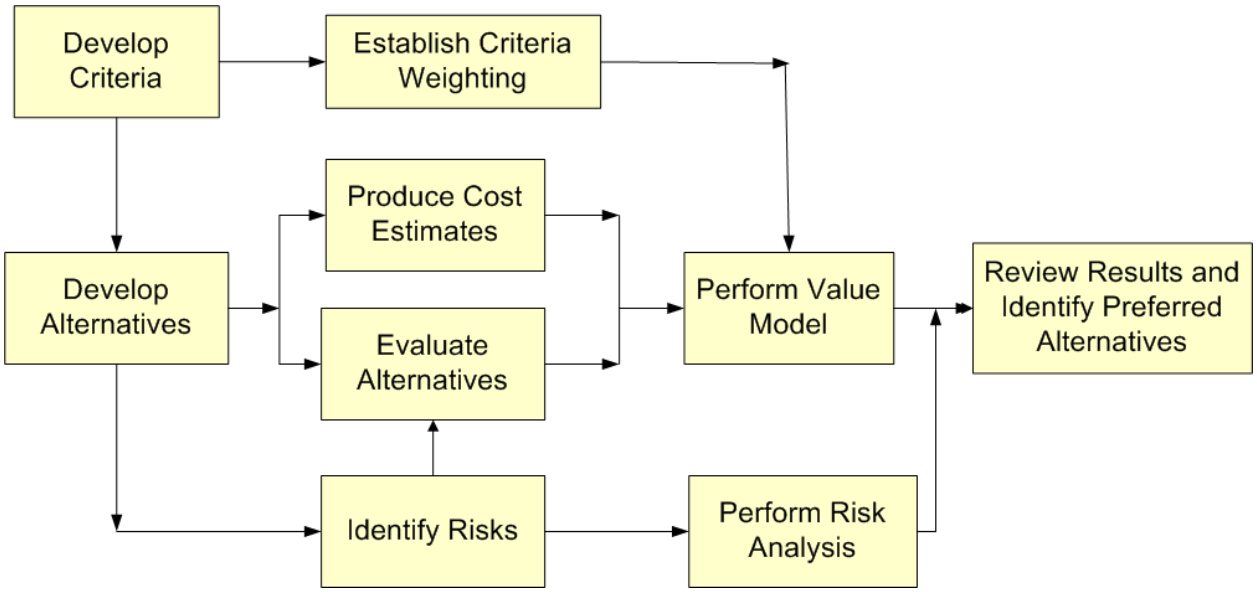

Figure 1 Triple Bottom Line Analysis Process Flowchart

3.1 Develop Criteria

Criteria is first defined by project stakeholders and then used to narrow and select project alternatives. The criteria developed should be factors or values that are identified to help achieve the project goal. The following list provides examples of criteria:

- Constructability
- Operation & Maintenance
- Property Impacts
- System Performance
- Schedule
- Community/Business
- Carbon Footprint
- Construction Impacts
- Ability to Work with Planned Projects
- Environmental Impacts
- Permitting
- Security
- Public Confidence
- System Flexibility

Also developed by the project stakeholders would be fatal flaw criteria, or the conditions for which an alternative would no longer be considered viable. For example, the following is an example of fatal flaw criteria. An alternative would be removed from further consideration if it did not meet all of the following conditions:

- Meets level of service,
- Reduces CSO frequency,
- Complies with CSO regulations,
- Can be accomplished within schedule, and
- Meets physical constraints.

Per the Scope of Services, criteria will be developed and selected under Subtask 941. The criteria will be developed in a workshop with a trained facilitator. For consistency, initial criteria will be developed from Seattle Public Utilities criteria with modifications based on input from the King County project stakeholders.

3.2 Establish Weighting Criteria

After developing the project criteria, it may be decided that some criteria may be more or less important than other criteria. Different team members faced with the same problem may have different underlying value systems, and, therefore, may have a different sense of what's most important in the given problem. This leads to the concept of "weighting" criteria.

Assigning weights to criteria is a subjective exercise which is based on the values of the project stakeholders. During a workshop, a trained facilitator can lead project stakeholders through an exercise designed for participants to think clearly about the relative importance of each criterion to meeting the project goal. The weight assigned to a criterion is a measure of that criterion's relative contribution to the project goal. It is also important to keep in mind which criterion can help differentiate alternatives from each other. For example, if all alternatives are given the same score for a criterion, that criterion may not be very useful in differentiating the alternatives. Conversely, if a criterion has a range of scores for the different alternatives, it may be beneficial to weigh that criterion more than other criterion to help differentiate alternatives.

3.3 Develop Alternatives

King County and the City of Seattle wastewater systems are intimately linked such that projects and activities in one system may influence the other system. CSO control alternatives must not have adverse impacts on the other system. This system linkage also may provide opportunities for more cost efficient solutions done as collaborative projects. As a result, development of alternatives for the King County 2012 CSO Control Program Review would occur under parallel processes and, subsequently, under two tasks per the Scope of Services. Task 900 would develop alternatives that are independent King County alternatives. Task 1000 would develop alternatives that are joint and collaborative projects for King County and Seattle Public Utilities.

3.4 Produce Cost Estimates

Cost estimates for alternatives would be developed in a consistent manner. Costs could include the following information:

- Capital costs
- Operations and Maintenance Costs

- Allied costs
- Contingency

A separate memorandum to be written on Cost Estimating Methodology for CSO Facilities will document the tools and approach to cost estimating for all alternatives.

3.5 Evaluate Alternatives

The next step in Triple Bottom Line Analysis would be to evaluate the alternatives developed. Evaluation of the alternatives would consist of screening the alternatives using the fatal flaw criteria developed and selected in the prior steps to determine if the alternative should continue to the next step. Screening alternatives would occur under Subtask 943 and Subtask 944, per the Scope of Services.

Figure 2 displays the logic behind the screening of alternatives during this step of Triple Bottom Line Analysis.

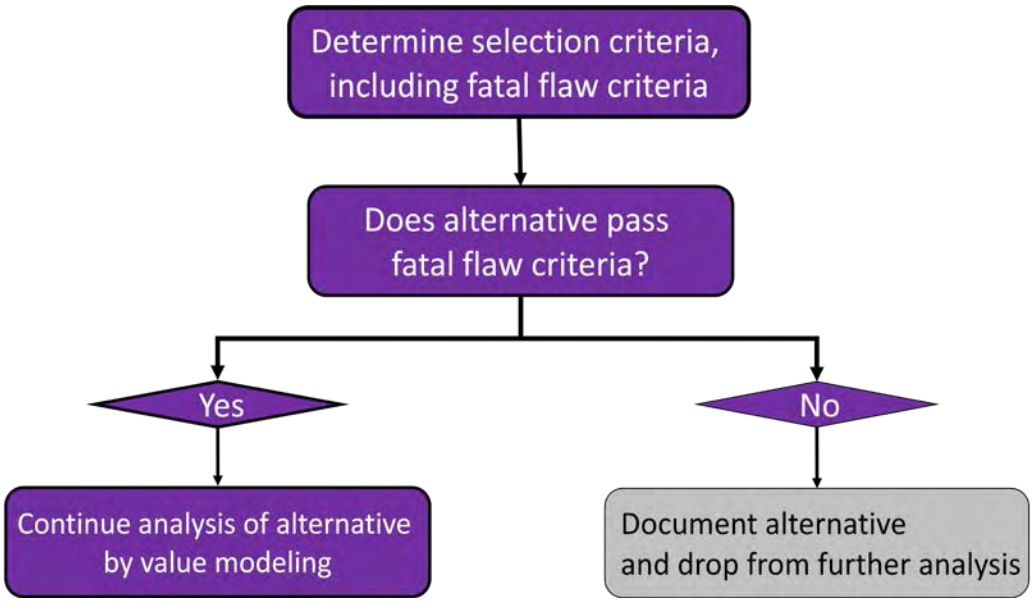

Figure 2 Alternative Screening Process

If an alternative passes the fatal flaw criteria, it will continue through the next steps of Triple Bottom Line Analysis. If the alternative does not pass the fatal flaw criteria, it will be documented and removed from further analysis.

3.6 Perform Value Modeling

Once the criteria are fully developed, performance measures are required to determine how well alternatives perform against the criteria. Performance measures may be quantitative or qualitative, depending upon the criterion and the availability of data for each measure.

After screening the alternatives, the alternatives moving forward to value modeling would be given scores for the project criteria. Rating or scoring alternatives is the process by which the performance scales are applied to the alternatives. Each alternative is scored to determine the extent to which that alternative meets each criterion. Scores for criteria are on a scale of 1 to 5. A score of “1” would mean the alternative does not meet the criterion and a score of “5” would

mean the alternative meets the criterion. Initial scoring would be completed by the project team and the scores would be reviewed by project stakeholders in a workshop.

Once the alternatives are given scores for the project criteria, the weights developed for the criteria in a previous step are applied to the scores. The process of calculating the total value score for an alternative using the criteria and the weights is called "value modeling". Value modeling outputs help to communicate why one alternative would be preferred over others.

Value modeling also provides a scatter diagram, which display the tradeoff between non-monetary value and cost. The scatter diagrams present the results of the value modeling, the total value scores, versus the total cost for each alternative. An example of a scatter diagram is shown in Figure 3.

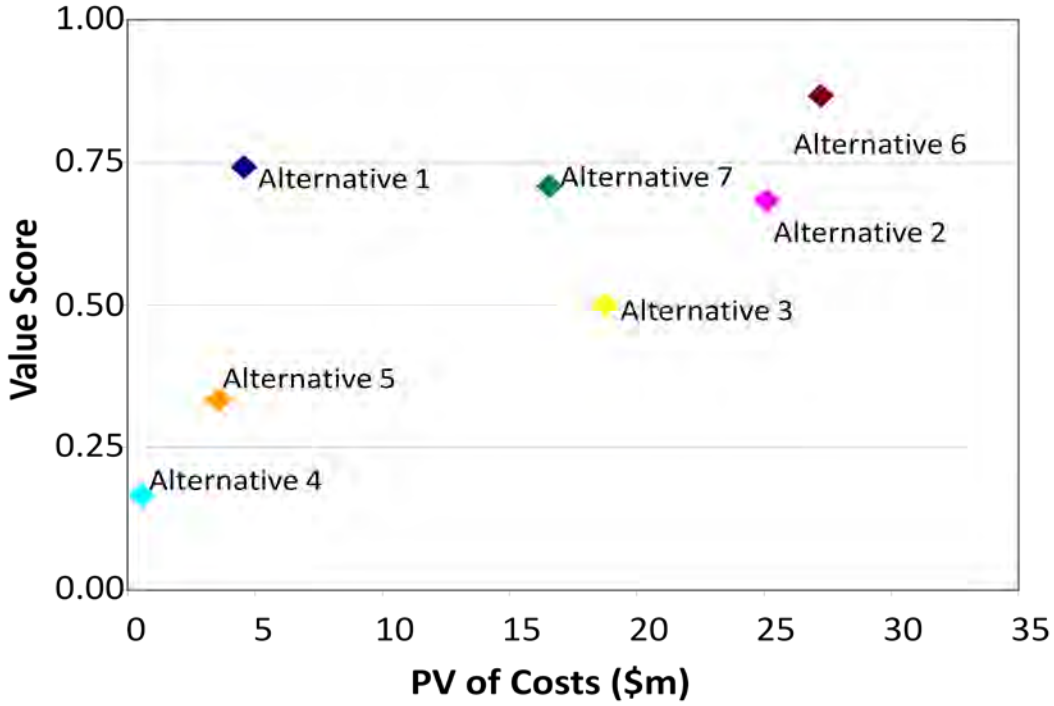

Figure 3 Value Modeling Scatter Diagram Example

There are different computer programs available to compute the actual value modeling. Value modeling can be done in Microsoft Office products, like Excel™ or through software like Decision Criterion Plus™. Given the amount of information available and likely the large number of alternatives, Decision Criterion Plus™ is suggested as the type of software for Value Modeling. Per the Scope of Services, value modeling would occur under Subtask 953 and Subtask 1032.

3.7 Identify Risks

When developing a criteria hierarchy for a value modeling analysis, one must decide whether all risks should be accounted for as criteria or in a separate accounting of risk. There is no "right answer" in how to account for risks. In the criteria selected, some may have an element of risk; however most likely, many of the criteria will not specifically focus on risk. Thus, it is important to consider if there are any risks not included in the value model analysis. In some cases, there may be multiple risks that the project team feels should be investigated.

Risk can be defined as the potential for realizing unwanted consequences of an event or the possibility that the event has an unfavorable outcome. Risk is measurable, and refers to situations where probabilities can be known. That is, the number and size of each possible outcome is known and the chance of each outcome occurring can be objectively determined. For example, in the case of throwing unbiased dice, the number of possible outcomes and their probabilities are known prior to the event.

Uncertainty can be defined as a broader set of cases in which the outcomes are recognized to be variable and not predictable, and in addition, their outcomes and probabilities may not be known or knowable in advance.

Both risk and uncertainty are frequent aspects of utility investment decisions. Some degree of uncertainty will be associated with almost any significant capital project or utility program. Utility capital projects tend to have long lives, which means that their life cycle cost analyses will extend far into the future, which is inherently uncertain. It is important to recognize the uncertainty and factor it into the overall economic analysis and evaluation supporting any decisions.

There are two different types of risk: quantitative and qualitative. Quantitative risks have probabilities and dollar outcomes that characterize each risk. Furthermore, cost impacts can be assessed for quantitative risks using statistical analysis. Examples of quantitative risks could be:

- Contaminated soil
- Dewatering ineffective
- Construction permit restrictions
- Community opposition
- Endangered species found
- Construction cost escalation
- Limited vehicle access
- Tunnel construction issue

Qualitative risks are risks that are difficult to monetize. Qualitative risks can be assessed using risk assessment framework, where the likelihood and consequence of each risk is evaluated. Examples of qualitative risks could be:

- Obtaining property difficult
- Alternative is not effective
- Archeological discovery made during construction
- System failure
- Community pressure
- Political pressure
- Lack of space

Risks would be identified by the project stakeholders in a facilitated process during which workshop participants would be asked to think of issues that could lead to added cost, schedule delay, or other undesirable outcomes. These issues would then be combined and grouped into

a set of risks for further evaluation. For the King County 2012 CSO Program Review, it is suggested that qualitative risks be used for Risk Analysis. With the amount of information available and likely the large number of alternatives, qualitative risks would adequately capture project risks at this level of development.

3.8 Perform Risk Analysis

Once the risks are identified, qualitative risks are scored based on their likelihood and consequence using a risk assessment framework. Risks would be initially scored by the project team with review from project stakeholders during a workshop. The risk assessment framework helps to analyze and communicate risks for high-level issues. An example risk assessment framework is shown in Figure 4.

RISK SIGNATURE LEVEL DETERMINANT

	Impact				
Likelihood	Insignificant	Minor	Moderate	Major	Extreme
Almost certain	M	M	H	C	C
Likely	M	M	H	C	C
Possible	L	M	M	H	H
Unlikely	L	L	M	H	H
Rare	L	L	M	M	M

L	Low
M	Medium
H	High
C	Critical

Figure 4 Risk Assessment Framework

Alternatives that have high or critical risks signify alternatives that may have issues to be addressed before they could be implemented successfully.

3.9 Review Results and Identify Preferred Alternatives

Using the results of the value modeling and risk analysis, alternatives can be compared to one another and preferred alternatives can be chosen. Since alternatives are to be developed in two parallel processes, independent King County alternatives and Joint King County/Seattle Public Utilities alternatives, the results will be reviewed in different phases.

First, the King County independent alternatives will be evaluated and compared against themselves. Next, the Joint King County/Seattle Public Utilities alternatives will be evaluated and compared against themselves. Finally, the “best” independent King County alternatives and the “best” Joint King County/Seattle Public Utilities alternatives will be compared against each other. The preferred alternative(s) would be selected from the better of the two different types of alternatives.

Appendix H.2

Environmental, Social, and Financial Metrics

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Appendix H.2.1

Value Scores and Weighting Factors

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Weighting Factor	*Category*	*Criteria*	*11th Ave NW Alternatives*		
			DSN004-STOR-1 (KC)	**DSN004-CON-1 (KC)**	**DSN004/008/014/015-STOR-1 (KC & SPU)**
20	***Technical Considerations***				
		Technical Complexity	3	3	1
		Flexibility/Adaptive Management	2	1	1
		Constructability	2	2	1
		Implementation Schedule	3	3	1
		Siting	2	3	3
		Coordination with Other King County Projects	1	1	1
0	***Cost Effectiveness***				
		Relative Life-Cycle Costs	2	3	2
20	***Community and Public Health***				
		Construction Impacts	2	1	3
		Potential Community Impacts	2	3	3
		Human Health	2	2	2
		Environmental/Social Justice	2	3	3
10	***Environmental Impacts***				
		Overall Environmental	3	3	3
		Sustainability	2	3	2
15	***Land Use and Permitting***				
		Permitting Complexity	2	2	2
35	***Operations &Maintenance***				
		Operations & Maintenance (O&M)	2	2	3
		Employee Safety	3	2	2
		Weighted Value Score	675	670	635

Value scores are based on criteria ratings from the preliminary alternative screening (September 2010).
Cells indicated in pink are value scores that were adjusted based on changes to the alternative since the preliminary alternative screening.

Weighting Factor	*Category*	*Criteria*	*3rd Ave W Alternatives*			
			DSN008-STOR-1 (KC)	**DSN008-STOR-2 (KC & SPU)**	**DSN008-STOR-5 (KC & SPU)**	**DSN004/008/014/015-STOR-1 (KC & SPU)**
20	***Technical Considerations***					
		Technical Complexity	3	2	1	1
		Flexibility/Adaptive Management	1	1	1	1
		Constructability	2	2	2	1
		Implementation Schedule	3	2	2	1
		Siting	2	3	2	3
		Coordination with Other King County Projects	1	1	1	1
0	***Cost Effectiveness***					
		Relative Life-Cycle Costs	2	2	2	2
20	***Community and Public Health***					
		Construction Impacts	1	2	1	3
		Potential Community Impacts	2	2	2	3
		Human Health	2	2	2	2
		Environmental/Social Justice	2	2	2	3
10	***Environmental Impacts***					
		Overall Environmental	3	3	3	3
		Sustainability	2	2	2	2
15	***Land Use and Permitting***					
		Permitting Complexity	1	3	1	2
35	***Operations &Maintenance***					
		Operations & Maintenance (O&M)	2	2	2	3
		Employee Safety	3	3	3	2
		Weighted Value Score	620	650	560	635

Value scores are based on criteria ratings from the preliminary alternative screening (September 2010).
Cells indicated in pink are value scores that were adjusted based on changes to the alternative since the preliminary alternative screening.

Weighting Factor	*Category*	*Criteria*	*Montlake Alternatives*		
			DSN014-STOR-1 (KC)	**DSN014-STOR-2 (KC & SPU)**	**DSN004/008/014/015-STOR-1 (KC & SPU)**
20	***Technical Considerations***				
		Technical Complexity	3	2	1
		Flexibility/Adaptive Management	2	2	1
		Constructability	2	2	1
		Implementation Schedule	2	2	1
		Siting	1	1	3
		Coordination with Other King County Projects	1	1	1
0	***Cost Effectiveness***				
		Relative Life-Cycle Costs	2	2	2
20	***Community and Public Health***				
		Construction Impacts	1	1	3
		Potential Community Impacts	2	2	3
		Human Health	2	2	2
		Environmental/Social Justice	2	2	3
10	***Environmental Impacts***				
		Overall Environmental	3	3	3
		Sustainability	2	2	2
15	***Land Use and Permitting***				
		Permitting Complexity	3	3	2
35	***Operations &Maintenance***				
		Operations & Maintenance (O&M)	2	2	3
		Employee Safety	3	3	2
		Weighted Value Score	630	610	635

Value scores are based on criteria ratings from the preliminary alternative screening (September 2010).
Cells indicated in pink are value scores that were adjusted based on changes to the alternative since the preliminary alternative screening.

Weighting Factor	*Category*	*Criteria*	*University Alternatives*		
			DSN015-STOR-1 (KC)	**DSN015-STOR-4 (KC & SPU)**	**DSN004/008/014/015-STOR-1 (KC & SPU)**
20	***Technical Considerations***				
		Technical Complexity	3	2	1
		Flexibility/Adaptive Management	1	1	1
		Constructability	2	2	1
		Implementation Schedule	2	2	1
		Siting	1	1	3
		Coordination with Other King County Projects	1	1	1
0	***Cost Effectiveness***				
		Relative Life-Cycle Costs	2	2	2
20	***Community and Public Health***				
		Construction Impacts	2	2	3
		Potential Community Impacts	2	2	3
		Human Health	2	2	2
		Environmental/Social Justice	2	2	3
10	***Environmental Impacts***				
		Overall Environmental	3	3	3
		Sustainability	2	2	2
15	***Land Use and Permitting***				
		Permitting Complexity	2	2	2
35	***Operations &Maintenance***				
		Operations & Maintenance (O&M)	2	2	3
		Employee Safety	3	3	2
		Weighted Value Score	615	595	635

Value scores are based on criteria ratings from the preliminary alternative screening (September 2010).
Cells indicated in pink are value scores that were adjusted based on changes to the alternative since the preliminary alternative screening.

Weighting Factor	*Category*	*Criteria*	*King Street Alternatives*				
			DSN028-STOR-1 (KC)	**DSN028-STOR-2 (KC & SPU)**	**DSN028/029-WWT-1 (KC)**	**DSN028/029/030/032-WWT-1 (KC)** New Conveyance to WWTF	**DSN028/029/030/032-WWT-1 (KC)** EBI Modifications
20	***Technical Considerations***						
		Technical Complexity	3	2	2	2	1
		Flexibility/Adaptive Management	1	1	2	1	2
		Constructability	2	2	3	2	3
		Implementation Schedule	3	2	2	2	1
		Siting	1	1	2	3	3
		Coordination with Other King County Projects	1	1	1	1	1
0	***Cost Effectiveness***						
		Relative Life-Cycle Costs	3	3	1	2	2
20	***Community and Public Health***						
		Construction Impacts	1	1	2	2	3
		Potential Community Impacts	3	3	3	3	3
		Human Health	2	2	3	3	3
		Environmental/Social Justice	2	2	2	3	3
10	***Environmental Impacts***						
		Overall Environmental	3	3	2	1	1
		Sustainability	3	3	1	2	2
15	***Land Use and Permitting***						
		Permitting Complexity	2	2	1	2	2
35	***Operations &Maintenance***						
		Operations & Maintenance (O&M)	2	2	1	2	2
		Employee Safety	3	3	2	2	2
		Weighted Value Score	645	605	590	640	660

Value scores are based on criteria ratings from the preliminary alternative screening (September 2010).
Cells indicated in pink are value scores that were adjusted based on changes to the alternative since the preliminary alternative screening.

After the preliminary alternatives screening process, two variations of DSN028/029/030/032-WWT-1 (KC) were developed and evaluated (New Conveyance to WWTF and EBI Modifications).

Weighting Factor	*Category*	*Criteria*	*Kingdome Alternatives*				
			DSN029-WWT-1 (KC)	**DSN029/030/032-WWT-1 (KC)**	**DSN028/029-WWT-1 (KC)**	**DSN028/029/030/032-WWT-1 (KC)** New Conveyance to WWTF	**DSN028/029/030/032-WWT-1 (KC)** EBI Modifications
20	***Technical Considerations***						
		Technical Complexity	2	2	2	2	1
		Flexibility/Adaptive Management	2	1	2	1	2
		Constructability	3	2	3	2	3
		Implementation Schedule	2	2	2	2	1
		Siting	1	3	2	3	3
		Coordination with Other King County Projects	1	1	1	1	1
0	***Cost Effectiveness***						
		Relative Life-Cycle Costs	1	2	1	2	2
20	***Community and Public Health***						
		Construction Impacts	1	2	2	2	3
		Potential Community Impacts	2	3	3	3	3
		Human Health	3	3	3	3	3
		Environmental/Social Justice	2	3	2	3	3
10	***Environmental Impacts***						
		Overall Environmental	2	1	2	1	1
		Sustainability	1	2	1	2	2
15	***Land Use and Permitting***						
		Permitting Complexity	1	2	1	2	2
35	***Operations &Maintenance***						
		Operations & Maintenance (O&M)	1	2	1	2	2
		Employee Safety	2	2	2	2	2
		Weighted Value Score	530	640	590	640	660

Value scores are based on criteria ratings from the preliminary alternative screening (September 2010).
Cells indicated in pink are value scores that were adjusted based on changes to the alternative since the preliminary alternative screening.

After the preliminary alternatives screening process, two variations of DSN028/029/030/032-WWT-1 (KC) were developed and evaluated (New Conveyance to WWTF and EBI Modifications).

Weighting Factor	*Category*	*Criteria*	*Lander Alternatives*				
			DSN030-WWT-1 (KC)	**DSN029/030/032-WWT-1 (KC)**	**DSN030/032-WWT-1 (KC)**	**DSN028/029/030/032-WWT-1 (KC)** New Conveyance to WWTF	**DSN028/029/030/032-WWT-1 (KC)** EBI Modifications
20	***Technical Considerations***						
		Technical Complexity	2	2	2	2	1
		Flexibility/Adaptive Management	3	1	2	1	2
		Constructability	3	2	3	2	3
		Implementation Schedule	3	2	3	2	1
		Siting	2	3	2	3	3
		Coordination with Other King County Projects	1	1	1	1	1
0	***Cost Effectiveness***						
		Relative Life-Cycle Costs	1	2	2	2	2
20	***Community and Public Health***						
		Construction Impacts	2	2	2	2	3
		Potential Community Impacts	3	3	3	3	3
		Human Health	3	3	3	3	3
		Environmental/Social Justice	2	3	2	3	3
10	***Environmental Impacts***						
		Overall Environmental	1	1	2	1	1
		Sustainability	1	2	1	2	2
15	***Land Use and Permitting***						
		Permitting Complexity	1	2	1	2	2
35	***Operations &Maintenance***						
		Operations & Maintenance (O&M)	1	2	2	2	2
		Employee Safety	2	2	2	2	2
		Weighted Value Score	620	640	645	640	660

Value scores are based on criteria ratings from the preliminary alternative screening (September 2010).
Cells indicated in pink are value scores that were adjusted based on changes to the alternative since the preliminary alternative screening.
After the preliminary alternatives screening process, two variations of DSN028/029/030/032-WWT-1 (KC) were developed and evaluated (New Conveyance to WWTF and EBI Modifications).

Weighting Factor	*Category*	*Criteria*	*Hanford #1 Alternatives*		
			DSN031-STOR-1 (KC)	**DSN031-STOR-4 (KC)**	**DSN031-CON-1 (KC)**
20	***Technical Considerations***				
		Technical Complexity	3	1	3
		Flexibility/Adaptive Management	1	2	2
		Constructability	2	2	2
		Implementation Schedule	3	2	3
		Siting	2	1	2
		Coordination with Other King County Projects	1	1	1
0	***Cost Effectiveness***				
		Relative Life-Cycle Costs	2	1	3
20	***Community and Public Health***				
		Construction Impacts	2	1	2
		Potential Community Impacts	2	2	2
		Human Health	3	3	3
		Environmental/Social Justice	2	2	2
10	***Environmental Impacts***				
		Overall Environmental	3	3	3
		Sustainability	2	2	3
15	***Land Use and Permitting***				
		Permitting Complexity	3	2	3
35	***Operations &Maintenance***				
		Operations & Maintenance (O&M)	3	2	3
		Employee Safety	3	3	3
		Weighted Value Score	725	595	755

Value scores are based on criteria ratings from the preliminary alternative screening (September 2010).
Cells indicated in pink are value scores that were adjusted based on changes to the alternative since the preliminary alternative screening.
Alternative DSN031-CON-1 (KC) was not evaluated as preliminary alternative.

Weighting Factor	*Category*	*Criteria*	*Hanford #2 Alternatives*				
			DSN032-WWT-1 (KC)	**DSN029/030/032-WWT-1 (KC)**	**DSN030/032-WWT-1 (KC)**	**DSN028/029/030/032-WWT-1 (KC)** New Conveyance to WWTF	**DSN028/029/030/032-WWT-1 (KC)** EBI Modifications
20	***Technical Considerations***						
		Technical Complexity	2	2	2	2	1
		Flexibility/Adaptive Management	3	1	2	1	2
		Constructability	3	2	3	2	3
		Implementation Schedule	3	2	3	2	1
		Siting	2	3	2	3	3
		Coordination with Other King County Projects	1	1	1	1	1
0	***Cost Effectiveness***						
		Relative Life-Cycle Costs	1	2	2	2	2
20	***Community and Public Health***						
		Construction Impacts	2	2	2	2	3
		Potential Community Impacts	3	3	3	3	3
		Human Health	3	3	3	3	3
		Environmental/Social Justice	2	3	2	3	3
10	***Environmental Impacts***						
		Overall Environmental	1	1	2	1	1
		Sustainability	1	2	1	2	2
15	***Land Use and Permitting***						
		Permitting Complexity	1	2	1	2	2
35	***Operations &Maintenance***						
		Operations & Maintenance (O&M)	1	2	2	2	2
		Employee Safety	2	2	2	2	2
		Weighted Value Score	620	640	645	640	660

Value scores are based on criteria ratings from the preliminary alternative screening (September 2010).
Cells indicated in pink are value scores that were adjusted based on changes to the alternative since the preliminary alternative screening.
After the preliminary alternatives screening process, two variations of DSN028/029/030/032-WWT-1 (KC) were developed and evaluated (New Conveyance to WWTF and EBI Modifications).

Weighting Factor	*Category*	*Criteria*	*Chelan Alternatives*		
			DSN036-STOR-1 (KC)	**DSN036-STOR-2 (KC)**	**DSN036-CON-1 (KC)**
20	***Technical Considerations***				
		Technical Complexity	2	1	1
		Flexibility/Adaptive Management	2	1	1
		Constructability	2	1	1
		Implementation Schedule	3	3	3
		Siting	2	3	3
		Coordination with Other King County Projects	2	2	2
0	***Cost Effectiveness***				
		Relative Life-Cycle Costs	3	3	1
20	***Community and Public Health***				
		Construction Impacts	2	2	1
		Potential Community Impacts	3	3	3
		Human Health	2	2	3
		Environmental/Social Justice	2	2	3
10	***Environmental Impacts***				
		Overall Environmental	3	3	2
		Sustainability	2	2	1
15	***Land Use and Permitting***				
		Permitting Complexity	3	3	1
35	***Operations &Maintenance***				
		Operations & Maintenance (O&M)	3	3	3
		Employee Safety	3	3	2
		Value Score	745	705	640

Value scores are based on criteria ratings from the preliminary alternative screening (September 2010).
Cells indicated in pink are value scores that were adjusted based on changes to the alternative since the preliminary alternative screening.
Alternative DSN036-STOR-2 (KC) was not evaluated as preliminary alternative.

Weighting Factor	*Category*	*Criteria*	*Terminal 115 Alternatives*	
			DSN038-STOR-1 (KC)	**DSN038/042-STOR-1 (KC)**
20	***Technical Considerations***			
		Technical Complexity	3	2
		Flexibility/Adaptive Management	2	2
		Constructability	2	2
		Implementation Schedule	3	3
		Siting	2	3
		Coordination with Other King County Projects	1	1
0	***Cost Effectiveness***			
		Relative Life-Cycle Costs	2	3
20	***Community and Public Health***			
		Construction Impacts	2	3
		Potential Community Impacts	3	3
		Human Health	2	2
		Environmental/Social Justice	2	2
10	***Environmental Impacts***			
		Overall Environmental	3	3
		Sustainability	2	2
15	***Land Use and Permitting***			
		Permitting Complexity	2	3
35	***Operations &Maintenance***			
		Operations & Maintenance (O&M)	2	3
		Employee Safety	3	3
		Weighted Value Score	695	765

Value scores are based on criteria ratings from the preliminary alternative screening (September 2010).
Cells indicated in pink are value scores that were adjusted based on changes to the alternative since the preliminary alternative screening.

Weighting Factor	*Category*	*Criteria*	*South Michigan Alternatives*		
			DSN039-WWT-1 (KC)	**DSN039/041-WWT-1 (KC)** New Conveyance to WWTF	**DSN039/041-WWT-1 (KC)** EBI Modifications
20	***Technical Considerations***				
		Technical Complexity	2	1	1
		Flexibility/Adaptive Management	3	1	2
		Constructability	3	2	3
		Implementation Schedule	3	3	1
		Siting	2	3	3
		Coordination with Other King County Projects	1	1	1
0	***Cost Effectiveness***				
		Relative Life-Cycle Costs	2	3	3
20	***Community and Public Health***				
		Construction Impacts	2	2	3
		Potential Community Impacts	3	3	3
		Human Health	3	3	3
		Environmental/Social Justice	2	2	2
10	***Environmental Impacts***				
		Overall Environmental	2	2	2
		Sustainability	1	1	1
15	***Land Use and Permitting***				
		Permitting Complexity	1	2	2
35	***Operations &Maintenance***				
		Operations & Maintenance (O&M)	1	2	2
		Employee Safety	2	2	2
		Weighted Value Score	630	620	640

Value scores are based on criteria ratings from the preliminary alternative screening (September 2010).
Cells indicated in pink are value scores that were adjusted based on changes to the alternative since the preliminary alternative screening.
After the preliminary alternatives screening process, two variations of DSN039/041-WWT-1 (KC) were developed and evaluated (New Conveyance to WWTF and EBI Modifications).

Weighting Factor	*Category*	*Criteria*	*Brandon Alternatives*			
			DSN041-SEP-1 (KC)	**DSN041-WWT-1 (KC)**	**DSN039/041-WWT-1 (KC)** New Conveyance to WWTF	**DSN039/041-WWT-1 (KC)** EBI Modifications
20	***Technical Considerations***					
		Technical Complexity	3	2	1	1
		Flexibility/Adaptive Management	2	3	1	2
		Constructability	3	3	2	3
		Implementation Schedule	3	3	3	1
		Siting	3	2	3	3
		Coordination with Other King County Projects	1	1	1	1
0	***Cost Effectiveness***					
		Relative Life-Cycle Costs	3	1	3	3
20	***Community and Public Health***					
		Construction Impacts	1	2	2	3
		Potential Community Impacts	3	3	3	3
		Human Health	3	3	3	3
		Environmental/Social Justice	2	2	2	2
10	***Environmental Impacts***					
		Overall Environmental	3	2	2	2
		Sustainability	3	1	1	1
15	***Land Use and Permitting***					
		Permitting Complexity	3	1	2	2
35	***Operations &Maintenance***					
		Operations & Maintenance (O&M)	3	1	2	2
		Employee Safety	3	2	2	2
		Weighted Value Score	795	630	620	640

Value scores are based on criteria ratings from the preliminary alternative screening (September 2010).
Cells indicated in pink are value scores that were adjusted based on changes to the alternative since the preliminary alternative screening.
After the preliminary alternatives screening process, two variations of DSN039/041-WWT-1 (KC) were developed and evaluated (New Conveyance to WWTF and EBI Modifications).

Weighting Factor	*Category*	*Criteria*	*West Michigan Alternatives*	
			DSN042-STOR-1 (KC)	**DSN038/042-STOR-1 (KC)**
20	***Technical Considerations***			
		Technical Complexity	3	2
		Flexibility/Adaptive Management	2	2
		Constructability	2	2
		Implementation Schedule	3	3
		Siting	2	3
		Coordination with Other King County Projects	1	1
0	***Cost Effectiveness***			
		Relative Life-Cycle Costs	2	3
20	***Community and Public Health***			
		Construction Impacts	2	3
		Potential Community Impacts	3	3
		Human Health	2	2
		Environmental/Social Justice	2	2
10	***Environmental Impacts***			
		Overall Environmental	3	3
		Sustainability	2	2
15	***Land Use and Permitting***			
		Permitting Complexity	2	3
35	***Operations &Maintenance***			
		Operations & Maintenance (O&M)	2	3
		Employee Safety	3	3
		Weighted Value Score	695	765

Value scores are based on criteria ratings from the preliminary alternative screening (September 2010).
Cells indicated in pink are value scores that were adjusted based on changes to the alternative since the preliminary alternative screening.

Appendix H.2.2

Risk Assessment

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KING COUNTY 2012 CSO CONTROL PROGRAM REVIEW
Alternatives Risk Assessment (Revised February 21, 2011)

Area: Ship Canal (11th Ave NW, 3rd Ave W, University, and Montlake)

		11th Avenue NW Alternatives		3rd Avenue W Alternatives			University Alternatives		Montlake Alternatives		11th Ave NW / 3rd Ave W / University / Montlake Alternative
		Storage	Conveyance	Storage	Storage w/SPU (South of Ship Canal)	Storage w/SPU (North of Ship Canal)	Storage	Storage w/SPU	Storage	Storage w/SPU	Storage Tunnel w/SPU
	Risk	SC-11th Ave NW-KC-STOR [DSN004-STOR-1 (KC)]	SC-11th Ave NW-KC-CONV [DSN004-CON-1 (KC)]	SC-3rd Ave W-KC-STOR [DSN008-STOR-1 (KC)]	SC-3rd Ave w-Collab-STOR 1 [DSN008-STOR-5 (KC & SPU)]	SC-3rd Ave W-Collab-STOR 2 [DSN008-STOR-2 (KC & SPU)]	SC-University-KC-STOR [DSN015-STOR-1 (KC)]	SC-University-Collab-STOR [DSN015-STOR-4 (KC & SPU)]	SC-Montlake-KC-STOR [DSN014-STOR-1 (KC)]	SC-Montlake-Collab-STOR [DSN014-STOR-2 (KC & SPU)]	SC-Cons Tunnel-Collab-STOR [DSN004/008/014/015-STOR-1 (KC & SPU)]
1	Construction for alternative is complex and constructability issues arise during CSO control project construction, resulting in major design/construction changes.	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** Construction is limited to the storage tank site and conveyance to and from the storage tank site.	**HIGH** **Likelihood - Likely** **Consequence - Moderate** Alternative includes a new 84" conveyance pipe along Shilshole Ave NW and NW 45th Street with complex utilities. Significant modifications are required at the Ballard Regulator Station.	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** Construction is limited to the storage tank site and conveyance to and from the storage tank site.	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** Construction is limited to the storage tank site and conveyance to and from the storage tank site.	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** Construction is limited to the storage tank site and conveyance to and from the storage tank site.	**HIGH** **Likelihood - Likely** **Consequence - Moderate** Alternative will likely include microtunneling to install the influent pipe to the storage tank due to deep excavation.	**HIGH** **Likelihood - Likely** **Consequence - Moderate** Alternative will likely include microtunneling to install the influent pipe to the storage tank due to deep excavation.	**HIGH** **Likelihood - Likely** **Consequence - Moderate** Alternative will likely include microtunneling to install the influent pipe to the storage tank due to deep excavation.	**HIGH** **Likelihood - Likely** **Consequence - Moderate** Alternative will likely include microtunneling to install the influent pipe to the storage tank due to deep excavation.	**CRITICAL** **Likelihood - Likely** **Consequence - Major** Alternative requires deep excavation for portals and tunnel construction. Tunnel may be located under Portage Bay.
2	Risk of equipment failure during peak event leads to increased overflows. Failure is more likely with a complex facility and/or where influent pumping is required.	**LOW** **Likelihood - Unlikely** **Consequence - Minor** Influent pumping to storage tank is not required.	**LOW** **Likelihood - Unlikely** **Consequence - Minor** Influent pumping to new conveyance pipe is not required.	**LOW** **Likelihood - Unlikely** **Consequence - Minor** Influent pumping to storage tank is not required.	**LOW** **Likelihood - Unlikely** **Consequence - Minor** Influent pumping to storage tank is not required.	**LOW** **Likelihood - Unlikely** **Consequence - Minor** Influent pumping to storage tank is not required.	**LOW** **Likelihood - Unlikely** **Consequence - Minor** Influent pumping to storage tank is not required.	**LOW** **Likelihood - Unlikely** **Consequence - Minor** Influent pumping to storage tank is not required.	**LOW** **Likelihood - Unlikely** **Consequence - Minor** Influent pumping to storage tank is not required.	**LOW** **Likelihood - Unlikely** **Consequence - Minor** Influent pumping to storage tank is not required.	**LOW** **Likelihood - Unlikely** **Consequence - Minor** Influent pumping of KC flows to new tunnel is not required.
3	Alternative requires complex controls to determine when flows need to be routed to CSO control facility. Facilities are operated more frequently than required, or CSO basin is not controlled due to complex operation.	**LOW** **Likelihood - Unlikely** **Consequence - Minor** One CSO site is controlled with a single storage tank. Diversion to storage tank is located at the 11th Ave NW Overflow Structure.	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** There may be complex controls at Ballard Regulator Station.	**LOW** **Likelihood - Unlikely** **Consequence - Minor** One CSO site is controlled with a single storage tank. Diversion to storage tank is located at the 3rd Ave W Overflow Structure.	**LOW** **Likelihood - Unlikely** **Consequence - Minor** Storage tank receives flows from King County and SPU. Diversion of KC and SPU flows to storage tank is located at the 3rd Ave W Overflow Structure.	**HIGH** **Likelihood - Likely** **Consequence - Moderate** Storage tank receives flows from King County and SPU. Diversion of KC flows to storage tank is located upstream of the 3rd Ave W Overflow Structure.	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** One CSO site is controlled with a single storage tank. Diversion to storage tank is located upstream of the University Regulator Station.	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** Storage tank receives flows from King County and SPU. Diversion of KC and SPU flows to storage tank is located upstream of the University Regulator Station.	**LOW** **Likelihood - Unlikely** **Consequence - Minor** One CSO site is controlled with a single storage tank. Diversion to storage tank is located at the Montlake Regulator Station.	**LOW** **Likelihood - Unlikely** **Consequence - Minor** Storage tank receives flows from King County and SPU. Diversion of KC and SPU flows to storage tank is located at the Montlake Regulator Station.	**HIGH** **Likelihood - Likely** **Consequence - Moderate** Four CSO sites are controlled with a single storage tunnel. There may be complex controls at regulator stations.
4	A new outfall for a wet-weather treatment facility and discharge to Duwamish River cannot be permitted or cannot be located in the Duwamish River.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5	Inability to obtain property necessary for construction of the CSO control project causes schedule delays and/or significant project changes.	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** There appers to be potential siting opportunities available in vicinity of 11th Ave NW Overflow Structure.	**LOW** **Likelihood - Possible** **Consequence - Minimal** It is not anticipated that property will be acquired as part of this alternative.	**CRITICAL** **Likelihood - Likely** **Consequence - Major** There appears to be limited siting opportunities in vicinity of 3rd Ave W Overflow Structure for size of storage tank without influent pumping.	**CRITICAL** **Likelihood - Likely** **Consequence - Major** There appears to be limited siting opportunities in vicinity of 3rd Ave W Overflow Structure for size of storage tank without influent pumping.	**HIGH** **Likelihood - Likely** **Consequence - Moderate** There appears to be potential siting opportunities available on the north side of the Ship Canal, but it may be difficult to acquire property large enough for joint storage tank.	**CRITICAL** **Likelihood - Likely** **Consequence - Major** There appears to be limited siting opportunities in vicinity of University Regulator Station.	**CRITICAL** **Likelihood - Likely** **Consequence - Major** There appears to be limited siting opportunities in vicinity of University Regulator Station.	**CRITICAL** **Likelihood - Likely** **Consequence - Major** There appears to be limited siting opportunities in vicinity of Montlake Regulator Station.	**CRITICAL** **Likelihood - Likely** **Consequence - Major** There appears to be limited siting opportunities in vicinity of Montlake Regulator Station.	**HIGH** **Likelihood - Likely** **Consequence - Moderate** There may be difficulty acquiring temporary construction easements for the west and east tunnel portals. East portal is located in vicinity of University Regulator, and west portal is located in vicinity of 3rd Ave W Overflow Structure.
6	Limited availability of trained staff to operate and maintain intermittent facilities.	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** This alternative requires multiple CSO control facilities to be operated and maintained during storm events for the 11th Ave NW, 3rd Ave W, University, and Montlake CSO basins.	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** This alternative requires that a conveyance pipe be cleaned and maintained.	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** This alternative requires multiple CSO control facilities to be operated and maintained during storm events for the 11th Ave NW, 3rd Ave W, University, and Montlake CSO basins.	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** This alternative requires multiple CSO control facilities to be operated and maintained during storm events for the 11th Ave NW, 3rd Ave W, University, and Montlake CSO basins.	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** This alternative requires multiple CSO control facilities to be operated and maintained during storm events for the 11th Ave NW, 3rd Ave W, University, and Montlake CSO basins.	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** This alternative requires multiple CSO control facilities to be operated and maintained during storm events for the 11th Ave NW, 3rd Ave W, University, and Montlake CSO basins.	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** This alternative requires multiple CSO control facilities to be operated and maintained during storm events for the 11th Ave NW, 3rd Ave W, University, and Montlake CSO basins.	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** This alternative requires multiple CSO control facilities to be operated and maintained during storm events for the 11th Ave NW, 3rd Ave W, University, and Montlake CSO basins.	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** This alternative requires multiple CSO control facilities to be operated and maintained during storm events for the 11th Ave NW, 3rd Ave W, University, and Montlake CSO basins.	**HIGH** **Likelihood - Likely** **Consequence - Moderate** This alternative requires one CSO storage tunnel to be operated and maintained during storm events for the 11th Ave NW, 3rd Ave W, University, and Montlake CSO basins.
7	Alternative requires coordination with AWV CSO Control Project and other SPU projects with potential impacts on schedule and project definitions.	**LOW** **Likelihood - Possible** **Consequence - Minimal** Alternative may require coordination with SPU.	**LOW** **Likelihood - Possible** **Consequence - Minimal** Alternative may require coordination with SPU.	**LOW** **Likelihood - Possible** **Consequence - Minimal** Alternative may require coordination with SPU.	**MEDIUM** **Likelihood - Almost Certain** **Consequence - Minor** This alternative includes a joint storage tank to control King County and SPU CSOs. Coordination with SPU would be required with potential impacts on schedule.	**MEDIUM** **Likelihood - Almost Certain** **Consequence - Minor** This alternative includes a joint storage tank to control King County and SPU CSOs. Coordination with SPU would be required with potential impacts on schedule.	**LOW** **Likelihood - Possible** **Consequence - Minimal** Alternative may require coordination with SPU.	**MEDIUM** **Likelihood - Almost Certain** **Consequence - Minor** This alternative includes a joint storage tank to control King County and SPU CSOs. Coordination with SPU would be required with potential impacts on schedule.	**LOW** **Likelihood - Possible** **Consequence - Minimal** Alternative may require coordination with SPU.	**MEDIUM** **Likelihood - Almost Certain** **Consequence - Minor** This alternative includes a joint storage tank to control King County and SPU CSOs. Coordination with SPU would be required with potential impacts on schedule.	**HIGH** **Likelihood - Almost Certain** **Consequence - Moderate** This alternative includes a joint storage tank to control King County and SPU CSOs. Coordination with SPU would be required with potential impacts on schedule.
8	Habitat project near planned facilities require modifications to the design.	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** Potential habitat programs and projects have not been identified in the vicinity of the 11th Ave NW CSO Outfall.	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** Potential habitat programs and projects have not been identified in the vicinity of the 11th Ave NW CSO Outfall.	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** Potential habitat programs and projects have been identified in the vicinity of the 3rd Ave W CSO Outfall (Watershed Water Resource Inventory Area 8, Project Number: M214).	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** Potential habitat programs and projects have been identified in the vicinity of the 3rd Ave W CSO Outfall (Watershed Water Resource Inventory Area 8, Project Number: M214).	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** Potential habitat programs and projects have been identified in the vicinity of the 3rd Ave W CSO Outfall (Watershed Water Resource Inventory Area 8, Project Number: M214).	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** Potential habitat programs and projects have been identified in the vicinity of the University CSO Outfall (Watershed Water Resource Inventory Area 8, Project Number: M216).	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** Potential habitat programs and projects have been identified in the vicinity of the University CSO Outfall (Watershed Water Resource Inventory Area 8, Project Number: M216).	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** Potential habitat programs and projects have been identified in the vicinity of the Montlake CSO Outfall (Watershed Water Resource Inventory Area 8, Project Number: M216).	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** Potential habitat programs and projects have been identified in the vicinity of the Montlake CSO Outfall (Watershed Water Resource Inventory Area 8, Project Number: M216).	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** Potential habitat programs and projects have been identified in the vicinity of the 3rd Ave W, University, and Montlake CSO Outfalls.
9	Regulatory agencies have not previously permitted the technology, so are conservative and cautious in approvals.	**LOW** **Likelihood - Unlikely** **Consequence - Minor** Regulatory agencies have permitted CSO storage tanks.	**LOW** **Likelihood - Unlikely** **Consequence - Minor** Regulatory agencies have permitted conveyance projects.	**LOW** **Likelihood - Unlikely** **Consequence - Minor** Regulatory agencies have permitted CSO storage tanks.	**LOW** **Likelihood - Unlikely** **Consequence - Minor** Regulatory agencies have permitted CSO storage tanks.	**LOW** **Likelihood - Unlikely** **Consequence - Minor** Regulatory agencies have permitted CSO storage tanks.	**LOW** **Likelihood - Unlikely** **Consequence - Minor** Regulatory agencies have permitted CSO storage tanks.	**LOW** **Likelihood - Unlikely** **Consequence - Minor** Regulatory agencies have permitted CSO storage tanks.	**LOW** **Likelihood - Unlikely** **Consequence - Minor** Regulatory agencies have permitted CSO storage tanks.	**LOW** **Likelihood - Unlikely** **Consequence - Minor** Regulatory agencies have permitted CSO storage tanks.	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** Regulatory agencies may be cautious with approval of a deep CSO storage tunnel.

KING COUNTY 2012 CSO CONTROL PROGRAM REVIEW
Alternatives Risk Assessment (Revised February 21, 2011)

Area: Ship Canal (11th Ave NW, 3rd Ave W, University, and Montlake)

		11th Avenue NW Alternatives		3rd Avenue W Alternatives			University Alternatives		Montlake Alternatives		11th Ave NW / 3rd Ave W / University / Montlake Alternative
		Storage	Conveyance	Storage	Storage w/SPU (South of Ship Canal)	Storage w/SPU (North of Ship Canal)	Storage	Storage w/SPU	Storage	Storage w/SPU	Storage Tunnel w/SPU
	Risk	SC-11th Ave NW-KC-STOR [DSN004-STOR-1 (KC)]	SC-11th Ave NW-KC-CONV [DSN004-CON-1 (KC)]	SC-3rd Ave W-KC-STOR [DSN008-STOR-1 (KC)]	SC-3rd Ave w-Collab-STOR 1 [DSN008-STOR-5 (KC & SPU)]	SC-3rd Ave W-Collab-STOR 2 [DSN008-STOR-2 (KC & SPU)]	SC-University-KC-STOR [DSN015-STOR-1 (KC)]	SC-University-Collab-STOR [DSN015-STOR-4 (KC & SPU)]	SC-Montlake-KC-STOR [DSN014-STOR-1 (KC)]	SC-Montlake-Collab-STOR [DSN014-STOR-2 (KC & SPU)]	SC-Cons Tunnel-Collab-STOR [DSN004/008/014/015-STOR-1 (KC & SPU)]
10	Few similar facilities have been built in the US, so few contractors have experience resulting in higher bids and change orders.	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** Similar facilities have been built throughout the US.	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** Similar facilities have been built throughout the US.	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** Similar facilities have been built throughout the US.	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** Similar facilities have been built throughout the US.	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** Similar facilities have been built throughout the US.	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** Similar facilities have been built throughout the US.	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** Similar facilities have been built throughout the US.	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** Similar facilities have been built throughout the US.	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** Similar facilities have been built throughout the US.	**HIGH** **Likelihood - Possible** **Consequence - Major** There may be few CSO storage tunnels of this size and type in the US.
11	Activist stakeholders are expected to press for a specific technology/project/location, resulting in schedule delays or selection of a higher cost alternative.	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** Stakeholders may press for a specific site location.	**LOW** **Likelihood - Possible** **Consequence - Minimal** Stakeholders may press for a different alignment for the new conveyance pipe, but it is anticipated this alternative would receive less opposition than a storage tank.	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** Stakeholders may press for a specific site location, and there appears to be limited siting opportunities in vicinity of 3rd Ave W Overflow Structure.	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** Stakeholders may press for a specific site location, and there appears to be limited siting opportunities in vicinity of 3rd Ave W Overflow Structure.	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** Stakeholders may press for a specific site location; however, there appears to be potential siting opportunities available on the north side of the Ship Canal.	**CRITICAL** **Likelihood - Likely** **Consequence - Major** Stakeholders are likely to press for a specific site location, and there appears to be limited siting opportunities in vicinity of University Regulator.	**CRITICAL** **Likelihood - Likely** **Consequence - Major** Stakeholders are likely to press for a specific site location, and there appears to be limited siting opportunities in vicinity of University Regulator.	**CRITICAL** **Likelihood - Likely** **Consequence - Major** Stakeholders are likely to press for a specific site location, and there appears to be limited siting opportunities in vicinity of Montlake Regulator.	**CRITICAL** **Likelihood - Likely** **Consequence - Major** Stakeholders are likely to press for a specific site location, and there appears to be limited siting opportunities in vicinity of Montlake Regulator.	**HIGH** **Likelihood - Likely** **Consequence - Moderate** Stakeholders are likely to press for a specific alignment and portal locations of the tunnel or alternatives to a tunnel.
12	CSO control volume or design flow rate may change during design based on refined modeling, resulting in a larger facility or change in alternative.	**LOW** **Likelihood - Possible** **Consequence - Minimal** Refined modeling may indicate a slight change in CSO control volume or design flow rate, but it is not anticipated to have a significant impact on the project.	**LOW** **Likelihood - Possible** **Consequence - Minimal** Refined modeling may indicate a slight change in CSO control volume or design flow rate, but it is not anticipated to have a significant impact on the project.	**LOW** **Likelihood - Possible** **Consequence - Minimal** Refined modeling may indicate a slight change in CSO control volume or design flow rate, but it is not anticipated to have a significant impact on the project.	**LOW** **Likelihood - Possible** **Consequence - Minimal** Refined modeling may indicate a slight change in CSO control volume or design flow rate, but it is not anticipated to have a significant impact on the project.	**HIGH** **Likelihood - Likely** **Consequence - Moderate** King County flows are diverted upstream of the 3rd Ave W Overflow Structure along the North Interceptor; modeling has not been completed to determine if the size of storage will increase based on the upstream diversion location to the joint storage tank.	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** King County flows are diverted along the North Interceptor just upstream of the University Regulator Station; modeling has not been completed to determine if the size of storage will increase based on the upstream diversion location to the joint storage tank.	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** King County flows are diverted along the North Interceptor just upstream of the University Regulator Station; modeling has not been completed to determine if the size of storage will increase based on the upstream diversion location to the joint storage tank.	**LOW** **Likelihood - Possible** **Consequence - Minimal** Refined modeling may indicate a slight change in CSO control volume or design flow rate, but it is not anticipated to have a significant impact on the project.	**LOW** **Likelihood - Possible** **Consequence - Minimal** Refined modeling may indicate a slight change in CSO control volume or design flow rate, but it is not anticipated to have a significant impact on the project.	**LOW** **Likelihood - Possible** **Consequence - Minimal** Refined modeling may indicate a slight change in CSO control volume or design flow rate, but it is not anticipated to have a significant impact on the project.
13	Transferring peak flows may have adverse downstream system impacts not identified by modeling.	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** This alternative does not include transferring of peak flows. Peak flows would be transferred to proposed storage tank.	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** Modeling evaluations indicate that increasing flows to the Ballard Siphon and ultimately to the West Point Treatment Plant have low impacts to the downstream conveyance system.	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** This alternative does not include transferring of peak flows. Peak flows would be transferred to proposed storage tank.	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** This alternative does not include transferring of peak flows. Peak flows would be transferred to proposed storage tank.	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** This alternative does not include transferring of peak flows. Peak flows would be transferred to proposed storage tank.	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** This alternative does not include transferring of peak flows. Peak flows would be transferred to proposed storage tank.	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** This alternative does not include transferring of peak flows. Peak flows would be transferred to proposed storage tank.	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** This alternative does not include transferring of peak flows. Peak flows would be transferred to proposed storage tank.	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** This alternative does not include transferring of peak flows. Peak flows would be transferred to proposed storage tank.	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** This alternative does not include transferring of peak flows. Peak flows would be transferred to proposed storage tunnel.

KING COUNTY 2012 CSO CONTROL PROGRAM REVIEW
Alternatives Risk Assessment (Revised February 21, 2011)

Area: Mid EBI (Hanford #2, Lander, King Street, and Kingdome)

	Risk	Hanford #2 / Lander / King Street / Kingdome Alternatives					
		Alternative A	**Alternative B**	**Alternative C**	**Alternative D-1**	**Alternative D-2**	**Alternative E**
		3 Independent Wet-weather Treatment Facilities + Storage	**2 Independent Wet-weather Treatment Facilities**	**2 Independent Wet-weather Treatment Facilities + Storage**	**1 Independent Wet-weather Treatment Facility**	**1 Independent Wet-weather Treatment Facility**	**1 Independent Wet-weather Treatment Facility + Storage**
					New Conveyance to WWTF	**EBI Modifications as Conveyance to WWTF**	
1	**Construction for alternative is complex and constructability issues arise during CSO control project construction, resulting in major design/construction changes.**	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** Construction is limited to the storage tank and WWTF sites and conveyance to and from these sites.	**HIGH** **Likelihood - Likely** **Consequence - Moderate** This alternative requires construction of two new CSO outfalls. Conveyance pipe from King St Regulator Station to WWTF is located in Alaskan Way S (busy street with crowded utility corridor), and the new pipe is 36 inches in diameter.	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** This alternative requires construction of one new CSO outfall.	**CRITICAL** **Likelihood - Likely** **Consequence - Major** Large conveyance pipes (48 to 84 inches in diameter) are required along Alaskan Way S and E Marginal Way S, which are busy streets and crowded utility corridors. Conveyance from King Street Regulator to Kingdome Regulator may conflict with WSDOT's AWVSRP and require an alignment on Port of Seattle property. New CSO outfall is also required.	**CRITICAL** **Likelihood - Likely** **Consequence - Major** A large gate and bypass structure is required along the 96" EBI in the vicinity of S Royal Brougham Way as well as a large diversion structure along the 96" EBI in the vicinity of S Hanford St to divert flows to the new WWTF. New CSO outfall is also required.	**HIGH** **Likelihood - Likely** **Consequence - Moderate** Large conveyance pipes (48 to 78 inches in diameter) are required along Alaskan Way S and E Marginal Way S, which are busy streets. This alternative does not include new conveyance from the King Street Regulator to Kingdome Regulator. New CSO outfall is also required.
2	**Risk of equipment failure during peak event leads to increased overflows. Failure is more likely with a complex facility and/or where influent pumping is required.**	**MEDIUM** **Likelihood - Likely** **Consequence - Minor** Alternative requires influent pumping to proposed WWTFs. It is assumed that the likelihood of one of the multiple WWTFs failing is higher than if it were a single WWTF, but the consequence would be lower (assuming only one of the three WWTFs fails).	**HIGH** **Likelihood - Likely** **Consequence - Moderate** Alternative requires influent pumping to proposed WWTFs. It is assumed that the likelihood of one of the WWTFs failing is higher than if it were a single WWTF, but the consequence would be lower (assuming only one of the two WWTF fails).	**HIGH** **Likelihood - Likely** **Consequence - Moderate** Alternative requires influent pumping to proposed WWTFs. It is assumed that the likelihood of one of the WWTFs failing is higher than if it were a single WWTF, but the consequence would be lower (assuming only one of the two WWTF fails).	**HIGH** **Likelihood - Unlikely** **Consequence - Major** Alternative requires influent pumping to proposed WWTF. It is assumed that the likelihood of a single WWTF failing is lower than if it were multiple WWTFs, but the consequence would be higher if it fails.	**HIGH** **Likelihood - UnLikely** **Consequence - Major** Alternative requires influent pumping to proposed WWTF as well as operation of multiple gates in the EBI to cause backflow to WWTF. It is assumed that the likelihood of a single WWTF failing is lower than if it were multiple WWTFs, but the consequence would be higher if it fails.	**HIGH** **Likelihood - Unlikely** **Consequence - Major** Alternative requires influent pumping to proposed WWTF. It is assumed that the likelihood of a single WWTF failing is lower than if it were multiple WWTFs, but the consequence would be higher if it fails.
3	**Alternative requires complex controls to determine when flows need to be routed to CSO control facility. Facilities are operated more frequently than required, or CSO basin is not controlled due to complex operation.**	**LOW** **Likelihood - Unlikely** **Consequence - Minor** Four CSO sites are controlled with four separate CSO control facilities. Diversions to CSO control facilities are located at regulator stations.	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** Four CSO sites are controlled with two WWTFs. Diversions to WWTFs are located at regulator stations.	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** Four CSO sites are controlled with three CSO control facilities. Diversions to CSO control facilities are located at regulator stations.	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** Four CSO sites are controlled with one WWTF. Diversions to WWTF are located at regulator stations.	**HIGH** **Likelihood - Possible** **Consequence - Major** Four CSO sites are controlled with one WWTF. Complex controls are required to determine when EBI gate near the Kingdome Regulator closes to backflow flows to the WWTF at Hanford #2 and control the four CSO sites.	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** Four CSO sites are controlled with two CSO control facilities. Diversions to CSO control facilities are located at regulator stations.
4	**A new outfall for a wet-weather treatment facility and discharge to Duwamish River cannot be permitted or cannot be located in the Duwamish River.**	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** New CSO outfalls may not be required for three WWTFs due to adequate capacity. However, existing CSO outfalls will likely be modified to become submerged outfalls.	**HIGH** **Likelihood - Possible** **Consequence - Major** New CSO outfalls would be required at Kingdome and Hanford #2 for the two WWTFs to convey treated CSOs to receiving water bodies (one outfall would discharge to Elliott Bay, and one outfall would discharge to Duwamish River). Existing CSO outfalls will likely be modified to become submerged outfalls.	**HIGH** **Likelihood - Possible** **Consequence - Major** One new CSO outfall would be required for the WWTF located at Hanford #2 to convey treated CSOs to the Duwamish River. Existing Kingdome CSO outfall will likely be modified to become a submerged outfall.	**CRITICAL** **Likelihood - Likely** **Consequence - Major** One new CSO outfall would be required for the WWTF located at Hanford #2 to convey treated CSOs to the Duwamish River. The peak flow rate for the new CSO outfall is higher than other alternatives (controlling four CSO sites); increased volume may have discharge impacts to river. Existing CSO outfalls will likely be modified to become submerged outfalls.	**CRITICAL** **Likelihood - Likely** **Consequence - Major** One new CSO outfall would be required for the WWTF located at Hanford #2 to convey treated CSOs to the Duwamish River. The peak flow rate for the new CSO outfall is higher than other alternatives (controlling four CSO sites); increased volume may have discharge impacts to river. Existing CSO outfalls will likely be modified to become submerged outfalls.	**CRITICAL** **Likelihood - Likely** **Consequence - Major** One new CSO outfall would be required for the WWTF located at Hanford #2 to convey treated CSOs to the Duwamish River. The peak flow rate for the new CSO outfall is higher than other alternatives (controlling three CSO sites); increased volume may have discharge impacts to river. Existing CSO outfalls will likely be modified to become submerged outfalls.

KING COUNTY 2012 CSO CONTROL PROGRAM REVIEW
Alternatives Risk Assessment (Revised February 21, 2011)

Area: Mid EBI (Hanford #2, Lander, King Street, and Kingdome)

		Hanford #2 / Lander / King Street / Kingdome Alternatives					
		Alternative A	Alternative B	Alternative C	Alternative D-1	Alternative D-2	Alternative E
		3 Independent Wet-weather Treatment Facilities + Storage	2 Independent Wet-weather Treatment Facilities	2 Independent Wet-weather Treatment Facilities + Storage	1 Independent Wet-weather Treatment Facility	1 Independent Wet-weather Treatment Facility	1 Independent Wet-weather Treatment Facility + Storage
Risk					New Conveyance to WWTF	EBI Modifications as Conveyance to WWTF	
5	Inability to obtain property necessary for construction of the CSO control project causes schedule delays and/or significant project changes.	CRITICAL Likelihood - Likely Consequence - Major Alternative includes four separate CSO control facilities along Elliott Bay/Duwamish River that require property/easement acquisition. There appears to be limited siting opportunities in vicinity of King Street and Kingdome Regulator Stations.	CRITICAL Likelihood - Likely Consequence - Major Alternative includes two separate WWTFs along Elliott Bay/Duwamish River that require property/easement acquisition. There appears to be limited siting opportunities in vicinity of Kingdome Regulator Station.	CRITICAL Likelihood - Likely Consequence - Major Alternative includes three separate CSO control facilities along Elliott Bay/Duwamish River that require property/easement acquisition. There appears to be limited siting opportunities in vicinity of King Street and Kingdome Regulator Stations.	HIGH Likelihood - Likely Consequence - Moderate There appears to be potential siting opportunities available in vicinity of Hanford St Regulator Station, but it may be difficult to acquire property for a WWTF of this size.	HIGH Likelihood - Likely Consequence - Moderate There appears to be potential siting opportunities available in vicinity of Hanford St Regulator Station, but it may be difficult to acquire property for a WWTF of this size.	HIGH Likelihood - Likely Consequence - Moderate There appears to be potential siting opportunities available in vicinity of Hanford St Regulator Station, but it may be difficult to acquire property for a WWTF of this size. There also appears to be limited siting opportunities in vicinity of the King St Regulator Station for a storage tank.
6	Limited availability of trained staff to operate and maintain intermittent facilities.	CRITICAL Likelihood - Likely Consequence - Major This alternative requires four separate CSO control facilities to be operated and maintained during storm events for the Hanford #2, Lander, Kingdome, and King St CSO basins.	HIGH Likelihood - Likely Consequence - Moderate This alternative requires two separate WWTFs to be operated and maintained during storm events for the Hanford #2, Lander, Kingdome, and King St CSO basins.	HIGH Likelihood - Likely Consequence - Moderate This alternative requires three separate CSO control facilities to be operated and maintained during storm events for the Hanford #2, Lander, Kingdome, and King St CSO basins.	MEDIUM Likelihood - Possible Consequence - Moderate This alternative requires one CSO control facility to be operated and maintained during storm events for the Hanford #2, Lander, Kingdome, and King St CSO basins.	MEDIUM Likelihood - Possible Consequence - Moderate This alternative requires one CSO control facility to be operated and maintained during storm events for the Hanford #2, Lander, Kingdome, and King St CSO basins.	HIGH Likelihood - Likely Consequence - Moderate This alternative requires two CSO control facilities to be operated and maintained during storm events for the Hanford #2, Lander, Kingdome, and King St CSO basins.
7	Alternative requires coordination with AWV CSO Control Project and other SPU projects with potential impacts on schedule and project definitions.	MEDIUM Likelihood - Almost Certain Consequence - Minor This alternative requires coordination with the AWV CSO Control Project. This alternative may also include a joint storage tank to control King County and SPU CSOs. Coordination with SPU would be required with potential impacts on schedule.	LOW Likelihood - Possible Consequence - Minimal Alternative may require coordination with SPU	MEDIUM Likelihood - Almost Certain Consequence - Minor This alternative requires coordination with the AWV CSO Control Project. This alternative may also include a joint storage tank to control King County and SPU CSOs. Coordination with SPU would be required with potential impacts on schedule.	LOW Likelihood - Possible Consequence - Minimal Alternative may require coordination with SPU.	LOW Likelihood - Possible Consequence - Minimal Alternative may require coordination with SPU.	MEDIUM Likelihood - Almost Certain Consequence - Minor This alternative requires coordination with the AWV CSO Control Project. This alternative may also include a joint storage tank to control King County and SPU CSOs. Coordination with SPU would be required with potential impacts on schedule.
8	Habitat project near planned facilities require modifications to the design.	LOW Likelihood - Unlikely Consequence - Minimal Potential habitat programs and projects have not been identified in the vicinity of the CSO outfalls.	LOW Likelihood - Unlikely Consequence - Minimal Potential habitat programs and projects have not been identified in the vicinity of the CSO outfalls.	LOW Likelihood - Unlikely Consequence - Minimal Potential habitat programs and projects have not been identified in the vicinity of the CSO outfalls.	LOW Likelihood - Unlikely Consequence - Minimal Potential habitat programs and projects have not been identified in the vicinity of the CSO outfalls.	LOW Likelihood - Unlikely Consequence - Minimal Potential habitat programs and projects have not been identified in the vicinity of the CSO outfalls.	LOW Likelihood - Unlikely Consequence - Minimal Potential habitat programs and projects have not been identified in the vicinity of the CSO outfalls.
9	Regulatory agencies have not previously permitted the technology, so are conservative and cautious in approvals.	HIGH Likelihood - Likely Consequence - Moderate Regulatory agencies have not yet permitted these types of treatment technologies (ballasted sedimentation or chemically enhanced primary treatment with lamella plates) for King County CSO control facilities. Very few CEPT with lamella WWTFs are in operation.	HIGH Likelihood - Likely Consequence - Moderate Regulatory agencies have not yet permitted these types of treatment technologies (ballasted sedimentation or chemically enhanced primary treatment with lamella plates) for King County CSO control facilities. Very few CEPT with lamella WWTFs are in operation.	HIGH Likelihood - Likely Consequence - Moderate Regulatory agencies have not yet permitted these types of treatment technologies (ballasted sedimentation or chemically enhanced primary treatment with lamella plates) for King County CSO control facilities. Very few CEPT with lamella WWTFs are in operation.	HIGH Likelihood - Likely Consequence - Moderate Regulatory agencies have not yet permitted these types of treatment technologies (ballasted sedimentation or chemically enhanced primary treatment with lamella plates) for King County CSO control facilities. Very few CEPT with lamella WWTFs are in operation.	HIGH Likelihood - Likely Consequence - Moderate Regulatory agencies have not yet permitted these types of treatment technologies (ballasted sedimentation or chemically enhanced primary treatment with lamella plates) for King County CSO control facilities. Very few CEPT with lamella WWTFs are in operation.	HIGH Likelihood - Likely Consequence - Moderate Regulatory agencies have not yet permitted these types of treatment technologies (ballasted sedimentation or chemically enhanced primary treatment with lamella plates) for King County CSO control facilities. Very few CEPT with lamella WWTFs are in operation.

KING COUNTY 2012 CSO CONTROL PROGRAM REVIEW
Alternatives Risk Assessment (Revised February 21, 2011)

Area: Mid EBI (Hanford #2, Lander, King Street, and Kingdome)

Risk		Alternative A	Alternative B	Alternative C	Alternative D-1	Alternative D-2	Alternative E
		Hanford #2 / Lander / King Street / Kingdome Alternatives					
		3 Independent Wet-weather Treatment Facilities + Storage	2 Independent Wet-weather Treatment Facilities	2 Independent Wet-weather Treatment Facilities + Storage	1 Independent Wet-weather Treatment Facility	1 Independent Wet-weather Treatment Facility	1 Independent Wet-weather Treatment Facility + Storage
					New Conveyance to WWTF	EBI Modifications as Conveyance to WWTF	
10	Few similar facilities have been built in the US, so few contractors have experience resulting in higher bids and change orders.	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** Similar facilities have been built throughout the US.	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** Similar facilities have been built throughout the US.	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** Similar facilities have been built throughout the US.	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** Similar facilities have been built throughout the US.	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** Similar facilities have been built throughout the US.	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** Similar facilities have been built throughout the US.
11	Activist stakeholders are expected to press for a specific technology/project/location, resulting in schedule delays or selection of a higher cost alternative.	**CRITICAL** **Likelihood - Likely** **Consequence - Major** Stakeholders are likely to press for specific locations for the WWTF in the vicinity of the Kingdome Regulator Station and the storage tank in the vicinity of the King St Regulator Station (commercial areas).	**HIGH** **Likelihood - Likely** **Consequence - Moderate** Stakeholders are likely to press for specific locations for the larger WWTFs in the vicinities of Kingdome Regulator Station and Hanford St Regulator Station (commercial and industrial areas).	**CRITICAL** **Likelihood - Likely** **Consequence - Major** Stakeholders are likely to press for specific locations for the WWTF in the vicinity of the Kingdome Regulator Station and the storage tank in the vicinity of the King St Regulator Station (commercial areas).	**HIGH** **Likelihood - Likely** **Consequence - Moderate** Stakeholders are likely to press for a specific location for the larger WWTF in the vicinity of the Hanford St Regulator Station (industrial area).	**HIGH** **Likelihood - Likely** **Consequence - Moderate** Stakeholders are likely to press for a specific location for the larger WWTF in the vicinity of the Hanford St Regulator Station (industrial area).	**CRITICAL** **Likelihood - Likely** **Consequence - Major** Stakeholders are likely to press for a specific location for the larger WWTF in the vicinity of the Hanford St Regulator Station (industrial area). Stakeholders are also likely to press for a specific location for the storage tank in the vicinity of the King St Regulator Station (commercial area).
12	CSO control volume or design flow rate may change during design based on refined modeling, resulting in a larger facility or change in alternative.	**LOW** **Likelihood - Possible** **Consequence - Minimal** Refined modeling may indicate a slight change in CSO control volume or design flow rate, but it is not anticipated to have a significant impact on the project.	**LOW** **Likelihood - Possible** **Consequence - Minimal** Refined modeling may indicate a slight change in CSO control volume or design flow rate, but it is not anticipated to have a significant impact on the project.	**LOW** **Likelihood - Possible** **Consequence - Minimal** Refined modeling may indicate a slight change in CSO control volume or design flow rate, but it is not anticipated to have a significant impact on the project.	**LOW** **Likelihood - Possible** **Consequence - Minimal** Refined modeling may indicate a slight change in CSO control volume or design flow rate, but it is not anticipated to have a significant impact on the project.	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** Flows are diverted from the EBI to the WWTF by closing the proposed EBI gate near the Kingdome Regulator Station. Refined modeling is required to account for travel times between each of the CSO sites as well as potential impact to size of WWTF based on the upstream diversions and backflow to the WWTF.	**LOW** **Likelihood - Possible** **Consequence - Minimal** Refined modeling may indicate a slight change in CSO control volume or design flow rate, but it is not anticipated to have a significant impact on the project.
13	Transferring peak flows may have adverse downstream system impacts not identified by modeling.	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** This alternative does not include transferring of peak flows. Peak flows would be transferred to proposed CSO control facilities.	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** This alternative does not include transferring of peak flows. Peak flows would be transferred to proposed CSO control facilities.	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** This alternative does not include transferring of peak flows. Peak flows would be transferred to proposed CSO control facilities.	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** This alternative does not include transferring of peak flows. Peak flows would be transferred to proposed WWTF.	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** This alternative does not include transferring of peak flows. Peak flows would be transferred to proposed WWTF.	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** This alternative does not include transferring of peak flows. Peak flows would be transferred to proposed CSO control facilities.

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KING COUNTY 2012 CSO CONTROL PROGRAM REVIEW
Alternatives Risk Assessment (Revised February 21, 2011)

Area: Mid EBI (Hanford #1/Hanford@Rainier)

	Risk	Hanford #1 Alternatives		
		One Storage Tank	Two Storage Tanks	Conveyance & Storage
		MEBI-Han-Rain-BV-KC-STOR 1 [DSN031-STOR-1 (KC)]	MEBI-Han-Rain-BV-KC-STOR 2 [DSN031-STOR-4 (KC)]	MEBI-Han-Rain-BV-KC-CONV/STOR [DSN031-CON-1 (KC)]
1	**Construction for alternative is complex and constructability issues arise during CSO control project construction, resulting in major design/construction changes.**	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** Alternative includes a deep new 72" conveyance pipe in Rainier Ave S with complex utilities.	**LOW** **Likelihood - Unlikely** **Consequence - Minor** Construction is limited to the storage tank sites and conveyance to and from the storage tank sites.	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** Alternative includes complex storm drain crossing for new conveyance. New conveyance pipe is installed with microtunneling due to deep excavation.
2	**Risk of equipment failure during peak event leads to increased overflows. Failure is more likely with a complex facility and/or where influent pumping is required.**	**LOW** **Likelihood - Unlikely** **Consequence - Minor** Influent pumping to storage tank is not required.	**LOW** **Likelihood - Unlikely** **Consequence - Minor** Influent pumping to storage tank is not required.	**LOW** **Likelihood - Unlikely** **Consequence - Minor** Influent pumping to storage tank is not required.
3	**Alternative requires complex controls to determine when flows need to be routed to CSO control facility. Facilities are operated more frequently than required, or CSO basin is not controlled due to complex operation.**	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** Two CSO sites are controlled with a single storage tank. Diversions to storage tank are located at Hanford@Rainier Overflow Structure and Bayview North Overflow Structure.	**LOW** **Likelihood - Unlikely** **Consequence - Minor** Two CSO sites are controlled with two storage tanks. Diversions to storage tanks are located a Hanford@Rainier Overflow Structure and Bayview North Overflow Structure.	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** Two CSO sites are controlled with a single storage tank and conveyance to the Bayview Tunnel. Diversion to storage tank is located at Hanford@Rainier Overflow Structure. Diversion to Bayview Tunnel is located at Bayview North Overflow Structure.
4	**A new outfall for a wet-weather treatment facility and discharge to Duwamish River cannot be permitted or cannot be located in the Duwamish River.**	NA	NA	NA
5	**Inability to obtain property necessary for construction of the CSO control project causes schedule delays and/or significant project changes.**	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** It may difficult to acquire property for this storage tank without an influent pump station.	**HIGH** **Likelihood - Likely** **Consequence - Moderate** Alternative includes two storage tanks located in close proximity to each other with limited siting availability, particulary in the vicinity of the Hanford@Rainier Overflow Structure.	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** There appers to be limited siting availability in vicinity of Hanford@Rainier Overflow Structure.
6	**Limited availability of trained staff to operate and maintain intermittent facilities.**	**LOW** **Likelihood - Possible** **Consequence - Minimal** This alternative requires one CSO storage tank to be operated and maintained during storm events for the Hanford #1 basin.	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** This alternative requires multiple CSO control facilities to be operated and maintained during storm events for the Hanford #1 CSO basin.	**LOW** **Likelihood - Possible** **Consequence - Minimal** This alternative requires one CSO storage tank to be operated and maintained during storm events for the Hanford #1 basin.
7	**Alternative requires coordination with AWV CSO Control Project and other SPU projects with potential impacts on schedule and project definitions.**	**LOW** **Likelihood - Possible** **Consequence - Minimal** Alternative may include minimal flow transfers from SPU.	**LOW** **Likelihood - Possible** **Consequence - Minimal** Alternative may include minimal flow transfers from SPU.	**LOW** **Likelihood - Possible** **Consequence - Minimal** Alternative may include minimal flow transfers from SPU.

KING COUNTY 2012 CSO CONTROL PROGRAM REVIEW
Alternatives Risk Assessment (Revised February 21, 2011)

Area: Mid EBI (Hanford #1/Hanford@Rainier)

	Risk	Hanford #1 Alternatives		
		One Storage Tank	Two Storage Tanks	Conveyance & Storage
		MEBI-Han-Rain-BV-KC-STOR 1 [DSN031-STOR-1 (KC)]	MEBI-Han-Rain-BV-KC-STOR 2 [DSN031-STOR-4 (KC)]	MEBI-Han-Rain-BV-KC-CONV/STOR [DSN031-CON-1 (KC)]
8	**Habitat project near planned facilities require modifications to the design.**	**MEDIUM** **Likelihood - Likely** **Consequence - Minor** Potential habitat programs and projects have been identified in the vicinity of the Hanford #1 CSO Outfall.	**MEDIUM** **Likelihood - Likely** **Consequence - Minor** Potential habitat programs and projects have been identified in the vicinity of the Hanford #1 CSO Outfall.	**MEDIUM** **Likelihood - Likely** **Consequence - Minor** Potential habitat programs and projects have been identified in the vicinity of the Hanford #1 CSO Outfall.
9	**Regulatory agencies have not previously permitted the technology, so are conservative and cautious in approvals.**	**LOW** **Likelihood - Unlikely** **Consequence - Minor** Regulatory agencies have permitted CSO storage tanks.	**LOW** **Likelihood - Unlikely** **Consequence - Minor** Regulatory agencies have permitted CSO storage tanks.	**LOW** **Likelihood - Unlikely** **Consequence - Minor** Regulatory agencies have permitted CSO storage tanks.
10	**Few similar facilities have been built in the US, so few contractors have experience resulting in higher bids and change orders.**	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** Similar facilities have been built throughout the US.	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** Similar facilities have been built throughout the US.	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** Similar facilities have been built throughout the US.
11	**Activist stakeholders are expected to press for a specific technology/project/location, resulting in schedule delays or selection of a higher cost alternative.**	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** Stakeholders may press for a specific site location.	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** Stakeholders may press for a specific site location.	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** Stakeholders may press for a specific site location.
12	**CSO control volume or design flow rate may change during design based on refined modeling, resulting in a larger facility or change in alternative.**	**LOW** **Likelihood - Possible** **Consequence - Minimal** Refined modeling may indicate a slight change in CSO control volume or design flow rate, but it is not anticipated to have a significant impact on the project.	**LOW** **Likelihood - Possible** **Consequence - Minimal** Refined modeling may indicate a slight change in CSO control volume or design flow rate, but it is not anticipated to have a significant impact on the project.	**LOW** **Likelihood - Possible** **Consequence - Minimal** Refined modeling may indicate a slight change in CSO control volume or design flow rate, but it is not anticipated to have a significant impact on the project.
13	**Transferring peak flows may have adverse downstream system impacts not identified by modeling.**	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** This alternative does not include transferring of peak flows. Peak flows would be transferred to proposed storage tank.	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** This alternative does not include transferring of peak flows. Peak flows would be transferred to proposed storage tanks.	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** Modeling has not yet evaluated the potential impacts of sending more flows to Hanford #2 and Lander, but it is anticipated that the increase in flows will have minimal impacts.

KING COUNTY 2012 CSO CONTROL PROGRAM REVIEW
Alternatives Risk Assessment (Revised February 21, 2011)

Area: South EBI (S Michigan and Brandon)

Risk		South Michigan Alternative	Brandon Alternatives		South Michigan and Brandon Alternatives	
		SEBI-SMichigan-KC-WWTF [DSN039-WWT-1 (KC)]	SEBI-Brandon-KC-WWTF [DSN041-WWT-1 (KC)]	SEBI-Brandon-KC-SEP [DSN041-SEP-1 (KC)]	SEBI-Cons Brandon-SMichigan-KC-WWTF [DSN039/041-WWT-1 (KC)]	SEBI-Cons Brandon-SMichigan-KC-WWTF [DSN039/041-WWT-1 (KC)]
					New Conveyance to WWTF	EBI Modifications as Conveyance to WWTF
1	**Construction for alternative is complex and constructability issues arise during CSO control project construction, resulting in major design/construction changes.**	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** Construction is limited to the WWTF site and conveyance to and from the site.	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** Construction is limited to the WWTF site and conveyance to and from the site.	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** Alternative requires identification and disconnection of every sanitary service on each individual property in basin. Alternative also requires construction of small-diameter pipe along eight separate streets and may require a central vacuum station.	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** Conveyance pipe (42 inches in diameter) is required along E Marginal Way S, which is the same corridor as the EBI. New CSO outfall is also required.	**HIGH** **Likelihood - Likely** **Consequence - Moderate** A large gate and bypass structure is required along the 60" EBI in the vicinity of the Brandon St Regulator Station as well as a large diversion structure along the 60" EBI in the vicinity of the S Michigan St Regulator Station to divert flows to the new WWTF. New CSO outfall is also required.
2	**Risk of equipment failure during peak event leads to increased overflows. Failure is more likely with a complex facility and/or where influent pumping is required.**	**HIGH** **Likelihood - Likely** **Consequence - Moderate** Alternative requires influent pumping to proposed WWTFs. It is assumed that the likelihood of one of the WWTFs failing is higher than if it were a single WWTF, but the consequence would be lower (assuming only one of the two WWTF fails).	**HIGH** **Likelihood - Likely** **Consequence - Moderate** Alternative requires influent pumping to proposed WWTFs. It is assumed that the likelihood of one of the WWTFs failing is higher than if it were a single WWTF, but the consequence would be lower (assuming only one of the two WWTF fails).	**HIGH** **Likelihood - Unlikely** **Consequence - Major** If sewer separation includes a vacuum sewer system or grinder pump system, equipment failure could result in overflowing of streets and private sewer backups.	**HIGH** **Likelihood - Unlikely** **Consequence - Major** Alternative requires influent pumping to proposed WWTF. It is assumed that the likelihood of a single WWTF failing is lower than if it were multiple WWTFs, but the consequence would be higher if it fails.	**HIGH** **Likelihood - UnLikely** **Consequence - Major** Alternative requires influent pumping to proposed WWTF as well as operation of multiple gates in the EBI to cause backflow to WWTF. It is assumed that the likelihood of a single WWTF failing is lower than if it were multiple WWTFs, but the consequence would be higher if it fails.
3	**Alternative requires complex controls to determine when flows need to be routed to CSO control facility. Facilities are operated more frequently than required, or CSO basin is not controlled due to complex operation.**	**LOW** **Likelihood - Unlikely** **Consequence - Minor** One CSO site is controlled with one WWTF. Diversions to WWTF is located at S Michigan St Regulator Station.	**LOW** **Likelihood - Unlikely** **Consequence - Minor** One CSO site is controlled with one WWTF. Diversion to WWTF is located at Brandon St Regulator Station.	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** CSO site is controlled by removing stormwater from the combined sewer system. Complex controls are not required for this alternative.	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** Two CSO sites are controlled with one WWTF. Diversions to WWTF are located at regulator stations.	**HIGH** **Likelihood - Likely** **Consequence - Moderate** Two CSO sites are controlled with one WWTF. Complex controls are required to determine when EBI gate near the Brandon St Regulator Station closes to backflow flows to the WWTF at S Michigan St Regulator Station and control the two CSO sites.

KING COUNTY 2012 CSO CONTROL PROGRAM REVIEW
Alternatives Risk Assessment (Revised February 21, 2011)

Area: South EBI (S Michigan and Brandon)

Risk		South Michigan Alternative	Brandon Alternatives		South Michigan and Brandon Alternatives	
		SEBI-SMichigan-KC-WWTF [DSN039-WWT-1 (KC)]	SEBI-Brandon-KC-WWTF [DSN041-WWT-1 (KC)]	SEBI-Brandon-KC-SEP [DSN041-SEP-1 (KC)]	SEBI-Cons Brandon-SMichigan-KC-WWTF [DSN039/041-WWT-1 (KC)]	SEBI-Cons Brandon-SMichigan-KC-WWTF [DSN039/041-WWT-1 (KC)]
					New Conveyance to WWTF	EBI Modifications as Conveyance to WWTF
4	**A new outfall for a wet-weather treatment facility and discharge to Duwamish River cannot be permitted or cannot be located in the Duwamish River.**	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** A new CSO outfall may not be required for the WWTF due to adequate capacity. Existing CSO outfall will likely be modified to become submerged outfall.	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** A new CSO outfall may not be required for the WWTF due to adequate capacity. Existing CSO outfall will likely be modified to become submerged outfall.	NA	**HIGH** **Likelihood - Likely** **Consequence - Moderate** One new CSO outfall would be required for the WWTF located at S Michigan St Regulator Station to convey treated CSOs to the Duwamish River. Existing CSO outfall will likely be modified to become submerged outfall.	**HIGH** **Likelihood - Likely** **Consequence - Moderate** One new CSO outfall would be required for the WWTF located at S Michigan St Regulator Station to convey treated CSOs to the Duwamish River. Existing CSO outfall will likely be modified to become submerged outfall.
5	**Inability to obtain property necessary for construction of the CSO control project causes schedule delays and/or significant project changes.**	**HIGH** **Likelihood - Likely** **Consequence - Moderate** There appears to be potential siting opportunities available in vicinity of S Michigan St Regulator Station, but it may be difficult to acquire property for a WWTF of this size.	**MEDIUM** **Likelihood - Likely** **Consequence - Minor** There appears to be potential siting opportunities available in vicinity of Brandon St Regulator Station, including property that is owned by the King County Wastewater Treatment Division.	**HIGH** **Likelihood - Likely** **Consequence - Moderate** Negotiations with property owners to acquire temporary construction easements to reconnect side sewers may be difficult.	**HIGH** **Likelihood - Likely** **Consequence - Moderate** There appears to be potential siting opportunities available in vicinity of S Michigan St Regulator Station, but it may be difficult to acquire property for a WWTF of this size.	**HIGH** **Likelihood - Likely** **Consequence - Moderate** There appears to be potential siting opportunities available in vicinity of S Michigan St Regulator Station, but it may be difficult to acquire property for a WWTF of this size.
6	**Limited availability of trained staff to operate and maintain intermittent facilities.**	**HIGH** **Likelihood - Likely** **Consequence - Moderate** This alternative requires two separate CSO control facilities to be operated and maintained during storm events for the S Michigan and Brandon CSO basins.	**HIGH** **Likelihood - Likely** **Consequence - Moderate** This alternative requires two separate CSO control facilities to be operated and maintained during storm events for the S Michigan and Brandon CSO basins.	**HIGH** **Likelihood - Possible** **Consequence - Major** Alternative may require King County to operate and maintain a new separated sewer system in the Brandon St CSO basin.	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** This alternative requires one CSO control facility to be operated and maintained during storm events for the S Michigan and Brandon CSO basins.	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** This alternative requires one CSO control facility to be operated and maintained during storm events for the S Michigan and Brandon CSO basins.
7	**Alternative requires coordination with AWV CSO Control Project and other SPU projects with potential impacts on schedule and project definitions.**	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** Alternative may include minimal flow transfers from SPU.	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** Alternative may include minimal flow transfers from SPU.	**CRITICAL** **Likelihood - Likely** **Consequence - Major** Alternative will likely require coordination with SPU regarding the operation of the storm and sanitary sewer systems. Alternative will also likely require stormwater approval through SPU that may require stormwater treatment.	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** Alternative may include minimal flow transfers from SPU.	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** Alternative may include minimal flow transfers from SPU.

KING COUNTY 2012 CSO CONTROL PROGRAM REVIEW
Alternatives Risk Assessment (Revised February 21, 2011)

Area: South EBI (S Michigan and Brandon)

Risk		South Michigan Alternative	Brandon Alternatives		South Michigan and Brandon Alternatives	
		SEBI-SMichigan-KC-WWTF [DSN039-WWT-1 (KC)]	SEBI-Brandon-KC-WWTF [DSN041-WWT-1 (KC)]	SEBI-Brandon-KC-SEP [DSN041-SEP-1 (KC)]	SEBI-Cons Brandon-SMichigan-KC-WWTF [DSN039/041-WWT-1 (KC)]	SEBI-Cons Brandon-SMichigan-KC-WWTF [DSN039/041-WWT-1 (KC)]
					New Conveyance to WWTF	EBI Modifications as Conveyance to WWTF
8	**Habitat project near planned facilities require modifications to the design.**	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** Potential habitat programs and projects have been identified in the vicinity of the S Michigan St CSO Outfall (Port of Seattle Habitat Plan project and Lower Duwamish Water Group/Superfund Program study area).	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** Potential habitat programs and projects have been identified in the vicinity of the Brandon St CSO Outfall (Lower Duwamish Water Group/Superfund Program edge of dredge area and NOAA Natural Resources Damage Assessment Port of Seattle habitat project).	**LOW** **Likelihood - Unlikely** **Consequence - Minor** Potential habitat programs and projects have been identified in the vicinity of the Brandon St CSO Outfall; however, there are no planned facilities near the habitat projects and CSO outfall.	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** Potential habitat programs and projects have been identified in the vicinity of the Brandon St CSO Outfall and S Michigan St CSO Outfall.	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** Potential habitat programs and projects have been identified in the vicinity of the Brandon St CSO Outfall and S Michigan St CSO Outfall.
9	**Regulatory agencies have not previously permitted the technology, so are conservative and cautious in approvals.**	**HIGH** **Likelihood - Likely** **Consequence - Moderate** Regulatory agencies have not yet permitted these types of treatment technologies (ballasted sedimentation or chemically enhanced primary treatment with lamella plates) for King County CSO control facilities. Very few CEPT with lamella WWTFs are in operation.	**HIGH** **Likelihood - Likely** **Consequence - Moderate** Regulatory agencies have not yet permitted these types of treatment technologies (ballasted sedimentation or chemically enhanced primary treatment with lamella plates) for King County CSO control facilities. Very few CEPT with lamella WWTFs are in operation.	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** Regulatory agencies may not approve disturbance to property owners to complete separation project.	**HIGH** **Likelihood - Likely** **Consequence - Moderate** Regulatory agencies have not yet permitted these types of treatment technologies (ballasted sedimentation or chemically enhanced primary treatment with lamella plates) for King County CSO control facilities. Very few CEPT with lamella WWTFs are in operation.	**HIGH** **Likelihood - Likely** **Consequence - Moderate** Regulatory agencies have not yet permitted these types of treatment technologies (ballasted sedimentation or chemically enhanced primary treatment with lamella plates) for King County CSO control facilities. Very few CEPT with lamella WWTFs are in operation.
10	**Few similar facilities have been built in the US, so few contractors have experience resulting in higher bids and change orders.**	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** Similar facilities have been built throughout the US.	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** Similar facilities have been built throughout the US.	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** Similar facilities have been built throughout the US.	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** Similar facilities have been built throughout the US.	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** Similar facilities have been built throughout the US.
11	**Activist stakeholders are expected to press for a specific technology/project/location, resulting in schedule delays or selection of a higher cost alternative.**	**HIGH** **Likelihood - Likely** **Consequence - Moderate** Stakeholders are likely to press for specific locations for the larger WWTF in the vicinity of the S Michigan St Regulator Station (industrial areas).	**HIGH** **Likelihood - Likely** **Consequence - Moderate** Stakeholders are likely to press for specific locations for the larger WWTF in the vicinity of the Brandon St Regulator Station (industrial area).	**HIGH** **Likelihood - Likely** **Consequence - Moderate** Stakeholders may oppose or press for a different project due to property impacts.	**HIGH** **Likelihood - Likely** **Consequence - Moderate** Stakeholders are likely to press for specific locations for the larger WWTF in the vicinity of the S Michigan St Regulator Station (industrial areas).	**HIGH** **Likelihood - Likely** **Consequence - Moderate** Stakeholders are likely to press for specific locations for the larger WWTF in the vicinity of the S Michigan St Regulator Station (industrial areas).

KING COUNTY 2012 CSO CONTROL PROGRAM REVIEW
Alternatives Risk Assessment (Revised February 21, 2011)

Area: South EBI (S Michigan and Brandon)

Risk		South Michigan Alternative	Brandon Alternatives		South Michigan and Brandon Alternatives	
		SEBI-SMichigan-KC-WWTF [DSN039-WWT-1 (KC)]	SEBI-Brandon-KC-WWTF [DSN041-WWT-1 (KC)]	SEBI-Brandon-KC-SEP [DSN041-SEP-1 (KC)]	SEBI-Cons Brandon-SMichigan-KC-WWTF [DSN039/041-WWT-1 (KC)]	SEBI-Cons Brandon-SMichigan-KC-WWTF [DSN039/041-WWT-1 (KC)]
					New Conveyance to WWTF	EBI Modifications as Conveyance to WWTF
12	**CSO control volume or design flow rate may change during design based on refined modeling, resulting in a larger facility or change in alternative.**	**LOW** **Likelihood - Possible** **Consequence - Minimal** Refined modeling may indicate a slight change in CSO control volume or design flow rate, but it is not anticipated to have a significant impact on the project.	**LOW** **Likelihood - Possible** **Consequence - Minimal** Refined modeling may indicate a slight change in CSO control volume or design flow rate, but it is not anticipated to have a significant impact on the project.	**HIGH** **Likelihood - Possible** **Consequence - Major** Refined modeling and side sewer investigations may indicate a change in CSO control volume or design flow rate, which may result in increased flows.	**LOW** **Likelihood - Possible** **Consequence - Minimal** Refined modeling may indicate a slight change in CSO control volume or design flow rate, but it is not anticipated to have a significant impact on the project.	**HIGH** **Likelihood - Likely** **Consequence - Moderate** Flows are diverted from the EBI to the WWTF by closing the proposed EBI gate near the Brandon St Regulator Station. Refined modeling is required to account for travel times between each of the CSO sites as well as potential impact to size of WWTF based on the upstream diversions and backflow to the WWTF.
13	**Transferring peak flows may have adverse downstream system impacts not identified by modeling.**	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** This alternative does not include transferring of peak flows. Peak flows would be transferred to proposed WWTF.	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** This alternative does not include transferring of peak flows. Peak flows would be transferred to proposed WWTF.	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** Stormwater flows are removed from combined sewer system; downstream impacts may not have been identified.	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** This alternative does not include transferring of peak flows. Peak flows would be transferred to proposed WWTF.	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** This alternative does not include transferring of peak flows. Peak flows would be transferred to proposed WWTF.

KING COUNTY 2012 CSO CONTROL PROGRAM REVIEW
Alternatives Risk Assessment (Revised February 21, 2011)

Area: West Duwamish (W Michigan and Terminal 115)

Risk		West Michigan Alternative	Terminal 115 Alternative	West Michigan/Terminal 115 Alternative
		WDUW-WMichigan-KC-STOR [DSN042-STOR-1 (KC)]	WDUW-Term 115-KC-STOR [DSN038-STOR-1 (KC)]	WDUW-Cons WMichigan-Term 115-KC-STOR [DSN038/042-STOR-1 (KC)]
1	**Construction for alternative is complex and constructability issues arise during CSO control project construction, resulting in major design/construction changes.**	**LOW** **Likelihood - Unlikely** **Consequence - Minor** Construction is limited to the storage pipe and conveyance to and from the storage pipe.	**LOW** **Likelihood - Unlikely** **Consequence - Minor** Construction is limited to the storage pipe and conveyance to and from the storage pipe.	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** Conveyance pipe from W Michigan St Regulator Station to the Terminal 115 Overflow Structure is located in W Marginal Way SW (busy street with crowded utility corridor); pipe is 18 inches in diameter. Renton Effluent Transfer System is located along W Marginal Way SW.
2	**Risk of equipment failure during peak event leads to increased overflows. Failure is more likely with a complex facility and/or where influent pumping is required.**	**LOW** **Likelihood - Unlikely** **Consequence - Minor** Influent pumping to storage pipe is not required.	**LOW** **Likelihood - Unlikely** **Consequence - Minor** Influent pumping to storage pipe is not required.	**LOW** **Likelihood - Unlikely** **Consequence - Minor** Influent pumping to storage pipe is not required.
3	**Alternative requires complex controls to determine when flows need to be routed to CSO control facility. Facilities are operated more frequently than required, or CSO basin is not controlled due to complex operation.**	**LOW** **Likelihood - Unlikely** **Consequence - Minor** One CSO site is controlled with one storage pipe. Diversion to storage pipe is located near the W Michigan St Regulator Station.	**LOW** **Likelihood - Unlikely** **Consequence - Minor** One CSO site is controlled with one storage pipe. Diversion to storage pipe is located near the Terminal 115 Overflow Structure.	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** Two CSO sites are controlled with a single storage pipe. Diversions to storage pipe are located at W Michigan St Regulator Station and Terminal 115 Overflow Structure.
4	**A new outfall for a wet-weather treatment facility and discharge to Duwamish River cannot be permitted or cannot be located in the Duwamish River.**	NA	NA	NA
5	**Inability to obtain property necessary for construction of the CSO control project causes schedule delays and/or significant project changes.**	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** It may difficult to locate the storage pipe within the existing ROW or an existing easement. However, there appears to be siting opportunities in the vicinity of the W Michigan St Regulator Station if property acquisition is required.	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** It may difficult to locate the storage pipe within the existing ROW or an existing easement. However, there appears to be siting opportunities in the vicinity of the Terminal 115 Overflow Structure if property acquisition is required.	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** It may difficult to locate the storage pipe within the existing ROW or an existing easement due to the Renton Effluent Transfer System. However, there appears to be siting opportunities in the vicinity of the Terminal 115 Overflow Structure if property acquisition is required.

KING COUNTY 2012 CSO CONTROL PROGRAM REVIEW
Alternatives Risk Assessment (Revised February 21, 2011)

Area: West Duwamish (W Michigan and Terminal 115)

Risk		West Michigan Alternative	Terminal 115 Alternative	West Michigan/Terminal 115 Alternative
		WDUW-WMichigan-KC-STOR [DSN042-STOR-1 (KC)]	WDUW-Term 115-KC-STOR [DSN038-STOR-1 (KC)]	WDUW-Cons WMichigan-Term 115-KC-STOR [DSN038/042-STOR-1 (KC)]
6	**Limited availability of trained staff to operate and maintain intermittent facilities.**	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** This alternative requires two CSO storage pipes to be operated and maintained during storm events for the W Michigan and Terminal 115 CSO basins.	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** This alternative requires two CSO storage pipes to be operated and maintained during storm events for the W Michigan and Terminal 115 CSO basins.	**LOW** **Likelihood - Possible** **Consequence - Minimal** This alternative requires one CSO storage pipe to be operated and maintained during storm events for the W Michigan and Terminal 115 CSO basins.
7	**Alternative requires coordination with AWV CSO Control Project and other SPU projects with potential impacts on schedule and project definitions.**	**LOW** **Likelihood - Possible** **Consequence - Minimal** Alternative may require coordination with SPU.	**LOW** **Likelihood - Possible** **Consequence - Minimal** Alternative may require coordination with SPU.	**LOW** **Likelihood - Possible** **Consequence - Minimal** Alternative may require coordination with SPU.
8	**Habitat project near planned facilities require modifications to the design.**	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** Potential habitat programs and projects have been identified in the vicinity of the W Michigan St CSO Outfall (Port of Seattle Habitat Plan project and Lower Duwamish Water Group/Superfund Program study area).	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** Potential habitat programs and projects have been identified in the vicinity of the Terminal 115 CSO Outfall (Lower Duwamish Water Group/Superfund Program dredge or excavate area).	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** Potential habitat programs and projects have been identified in the vicinity of the W Michigan St and Terminal 115 CSO Outfalls.
9	**Regulatory agencies have not previously permitted the technology, so are conservative and cautious in approvals.**	**LOW** **Likelihood - Unlikely** **Consequence - Minor** Regulatory agencies have permitted CSO storage pipes.	**LOW** **Likelihood - Unlikely** **Consequence - Minor** Regulatory agencies have permitted CSO storage pipes.	**LOW** **Likelihood - Unlikely** **Consequence - Minor** Regulatory agencies have permitted CSO storage pipes.
10	**Few similar facilities have been built in the US, so few contractors have experience resulting in higher bids and change orders.**	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** Similar facilities have been built throughout the US.	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** Similar facilities have been built throughout the US.	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** Similar facilities have been built throughout the US.
11	**Activist stakeholders are expected to press for a specific technology/project/location, resulting in schedule delays or selection of a higher cost alternative.**	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** Stakeholders may press for a specific site location.	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** Stakeholders may press for a specific site location.	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** Stakeholders may press for a specific site location.
12	**CSO control volume or design flow rate may change during design based on refined modeling, resulting in a larger facility or change in alternative.**	**LOW** **Likelihood - Possible** **Consequence - Minimal** Refined modeling may indicate a slight change in CSO control volume or design flow rate, but it is not anticipated to have a significant impact on the project.	**LOW** **Likelihood - Possible** **Consequence - Minimal** Refined modeling may indicate a slight change in CSO control volume or design flow rate, but it is not anticipated to have a significant impact on the project.	**LOW** **Likelihood - Possible** **Consequence - Minimal** Refined modeling may indicate a slight change in CSO control volume or design flow rate, but it is not anticipated to have a significant impact on the project.
13	**Transferring peak flows may have adverse downstream system impacts not identified by modeling.**	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** This alternative does not include transferring of peak flows. Peak flows would be transferred to proposed storage pipe.	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** This alternative does not include transferring of peak flows. Peak flows would be transferred to proposed storage pipe.	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** This alternative does not include transferring of peak flows. Peak flows would be transferred to proposed storage pipe.

KING COUNTY 2012 CSO CONTROL PROGRAM REVIEW
Alternatives Risk Assessment (Revised February 21, 2011)

Area: West Duwamish (Chelan)

		Chelan Avenue Alternatives		
		Storage at Chelan Ave Regulator	**Storage at West Seattle PS**	**Conveyance to Alki Treatment Plant**
Risk		**WDUW-Chelan-KC-STOR 1 [DSN036-STOR-1 (KC)]**	**WDUW-Chelan-KC-STOR 2 [DSN036-STOR-2 (KC)]**	**WDUW-Chelan-KC-CONV [DSN036-CON-1 (KC)]**
1	**Construction for alternative is complex and constructability issues arise during CSO control project construction, resulting in major design/construction changes.**	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** Construction is limited to the storage tank site, conveyance to and from the storage tank site, and modifications to the Alki Tunnel.	**HIGH** **Likelihood - Likely** **Consequence - Moderate** Construction of two 90-ft-diameter caissons (approximately 70 feet deep) is required adjacent to the West Seattle Pump Station. Land fill is across the street from site with potential migration of groundwater plumes.	**CRITICAL** **Likelihood - Likely** **Consequence - Major** Alternative requires either a new CSO outfall at the Alki Treatment Plant or modifications to the existing CSO outfall. Modifications to the existing 63rd Pump Station are also required.
2	**Risk of equipment failure during peak event leads to increased overflows. Failure is more likely with a complex facility and/or where influent pumping is required.**	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** Influent pumping to storage tank is not required. However, failure of the flow control device in the Alki Tunnel could result in increased overflows at the Harbor Ave CSO Outfall.	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** Influent pumping to storage tank is not required. However, failure of the flow control device in the Alki Tunnel could result in increased overflows at the Harbor Ave CSO Outfall.	**HIGH** **Likelihood - Likely** **Consequence - Moderate** Alternative requires influent pumping to proposed WWTF.
3	**Alternative requires complex controls to determine when flows need to be routed to CSO control facility. Facilities are operated more frequently than required, or CSO basin is not controlled due to complex operation.**	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** One CSO site is controlled with one storage tank. Diversion to storage tank is located at the Chelan Ave Regulator Station. There is also a flow control device located in the Alki Tunnel to limit flows from the Alki CSO basin and control Harbor Ave CSOs.	**HIGH** **Likelihood - Likely** **Consequence - Moderate** Diversion of flows to storage tank is located upstream of the Chelan Ave Regulator Station. There is also a flow control device located in the Alki Tunnel to limit flows from the Alki CSO basin and control Harbor Ave CSOs.	**CRITICAL** **Likelihood - Likely** **Consequence - Major** Diversion of Chelan Ave flows to West Seattle Tunnel (and ultimately the Alki treatment plant) is located upstream of the Chelan Ave Regulator Station. Complex controls are required to divert flows to the Alki Treatment Plant with potential for SSOs at 63rd Pump Station.
4	**A new outfall for a wet-weather treatment facility and discharge to Duwamish River cannot be permitted or cannot be located in the Duwamish River.**	NA	NA	NA

KING COUNTY 2012 CSO CONTROL PROGRAM REVIEW
Alternatives Risk Assessment (Revised February 21, 2011)

Area: West Duwamish (Chelan)

		Chelan Avenue Alternatives		
		Storage at Chelan Ave Regulator	**Storage at West Seattle PS**	**Conveyance to Alki Treatment Plant**
Risk		**WDUW-Chelan-KC-STOR 1 [DSN036-STOR-1 (KC)]**	**WDUW-Chelan-KC-STOR 2 [DSN036-STOR-2 (KC)]**	**WDUW-Chelan-KC-CONV [DSN036-CON-1 (KC)]**
5	**Inability to obtain property necessary for construction of the CSO control project causes schedule delays and/or significant project changes.**	**HIGH** **Likelihood - Likely** **Consequence - Moderate** Property in vicinity of Chelan Ave Regulator Station is primarily owned by the Port of Seattle. It may be difficult to acquire property from the Port of Seattle.	**LOW** **Likelihood - Unlikely** **Consequence - Minor** The West Seattle Pump Station site is owned by the King County Wastewater Treatment Division. It is not anticipated that additional property would need to be acquired.	**HIGH** **Likelihood - Possible** **Consequence - Major** The upgrades to the 63rd Pump Station and Alki Treatment Plant are expected to occur within the existing properties owned by King County. If additional property needs to be acquired, there appears to be limited siting opportunities in these areas.
6	**Limited availability of trained staff to operate and maintain intermittent facilities.**	**LOW** **Likelihood - Possible** **Consequence - Minimal** This alternative requires one CSO control facility to be operated and maintained during storm events for the Chelan Ave basin.	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** This alternative requires that two deep caissons be cleaned and maintained.	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** This alternative requires that the Alki Treatment Plant be upgraded, so this alternative requires one CSO control facility to be operated and maintained during storm events.
7	**Alternative requires coordination with AWV CSO Control Project and other SPU projects with potential impacts on schedule and project definitions.**	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** Alternative may require coordination with SPU.	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** Alternative may require coordination with SPU.	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** Alternative may require coordination with SPU.
8	**Habitat project near planned facilities require modifications to the design.**	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** Potential habitat programs and projects have not been identified in the vicinity of the Chelan Ave CSO Outfall.	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** Potential habitat programs and projects have not been identified in the vicinity of the Chelan Ave CSO Outfall.	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** Potential habitat programs and projects have not been identified in the vicinity of the Chelan Ave CSO Outfall.
9	**Regulatory agencies have not previously permitted the technology, so are conservative and cautious in approvals.**	**LOW** **Likelihood - Unlikely** **Consequence - Minor** Regulatory agencies have permitted CSO storage tanks.	**LOW** **Likelihood - Unlikely** **Consequence - Minor** Regulatory agencies have permitted CSO storage tanks.	**HIGH** **Likelihood - Likely** **Consequence - Moderate** Alternative requires modifications to the Alki Treatment Plant and CSO outfall. Regulatory agencies may be cautious with approvals.
10	**Few similar facilities have been built in the US, so few contractors have experience resulting in higher bids and change orders.**	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** Similar facilities have been built throughout the US.	**LOW** **Likelihood - Unlikely** **Consequence - Minimal** Similar facilities have been built throughout the US.	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** Alternative requires modifications to existing facilities.

KING COUNTY 2012 CSO CONTROL PROGRAM REVIEW
Alternatives Risk Assessment (Revised February 21, 2011)

Area: West Duwamish (Chelan)

		Chelan Avenue Alternatives		
		Storage at Chelan Ave Regulator	**Storage at West Seattle PS**	**Conveyance to Alki Treatment Plant**
Risk		**WDUW-Chelan-KC-STOR 1 [DSN036-STOR-1 (KC)]**	**WDUW-Chelan-KC-STOR 2 [DSN036-STOR-2 (KC)]**	**WDUW-Chelan-KC-CONV [DSN036-CON-1 (KC)]**
11	**Activist stakeholders are expected to press for a specific technology/project/location, resulting in schedule delays or selection of a higher cost alternative.**	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** Stakeholders may press for a specific site location.	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** Stakeholders may press for a different alignment for the new conveyance pipe, but it is anticipated this storage alternative would receive less opposition than the other alternatives.	**MEDIUM** **Likelihood - Possible** **Consequence - Minor** Stakeholders may press for a specific site location if additional property needs to be acquired for the upgrades to existing facilities. However, it is not anticipated that additional property will be required.
12	**CSO control volume or design flow rate may change during design based on refined modeling, resulting in a larger facility or change in alternative.**	**LOW** **Likelihood - Possible** **Consequence - Minimal** Refined modeling may indicate a slight change in CSO control volume or design flow rate, but it is not anticipated to have a significant impact on the project.	**HIGH** **Likelihood - Likely** **Consequence - Moderate** Flows are diverted upstream of the Chelan Ave Regulator Station; modeling has not been completed to determine if the size of storage will increase based on the upstream diversion location to the storage tank.	**HIGH** **Likelihood - Likely** **Consequence - Moderate** Flows are diverted upstream of the Chelan Ave Regulator Station; modeling has not been completed to determine if higher peak flows need to be diverted to the Harbor CSO pipeline, West Seattle Tunnel, and ultimately the Alki Treatment Plant. Flow rate may increase based on the upstream diversion location to the Harbor CSO pipeline.
13	**Transferring peak flows may have adverse downstream system impacts not identified by modeling.**	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** Installing a new flow control device in the Alki Tunnel will control Harbor Ave CSOs (as the design originally intended); however, limiting flows to the West Seattle Tunnel would cause the Alki Treatment Plant to operate more frequently. Potential impacts to 63rd Pump Station and the Alki Treatment Plant need to be evaluated.	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** Installing a new flow control device in the Alki Tunnel will control Harbor Ave CSOs (as the design originally intended); however, limiting flows to the West Seattle Tunnel would cause the Alki Treatment Plant to operate more frequently. Potential impacts to 63rd Pump Station and the Alki Treatment Plant need to be evaluated.	**MEDIUM** **Likelihood - Possible** **Consequence - Moderate** Potential impacts of sending Harbor and Chelan CSOs to the 63rd Pump Station and Alki Treatment Plant needs to be modeled.

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Appendix H.3

Results of Triple-Bottom-Line Analysis

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Appendix H.3.1

Results of Triple-Bottom-Line Analysis: Ship Canal

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Summary of Screening Process

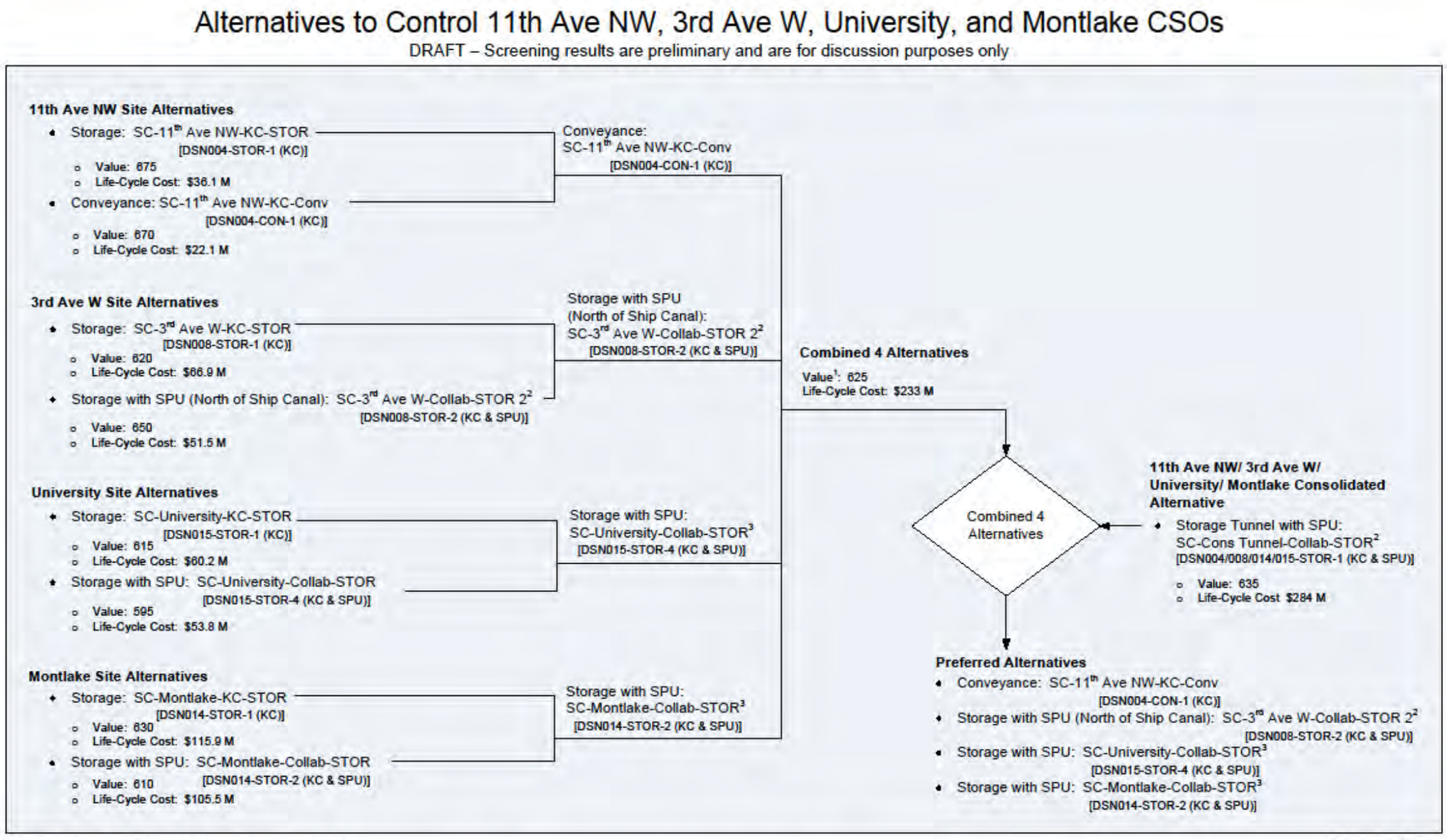

Figure H.3.1-1. Ship Canal Alternatives Screening Bracket

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Site Alternative Comparisons

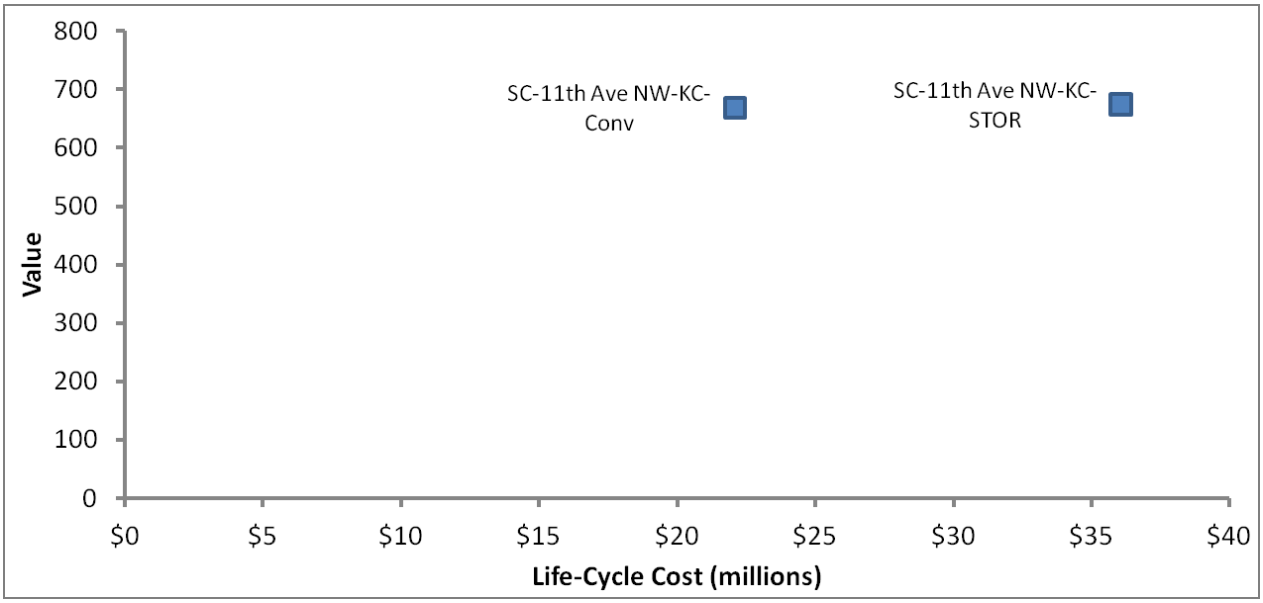

Figure H.3.1-2. Site Alternative Comparison: 11th Ave NW

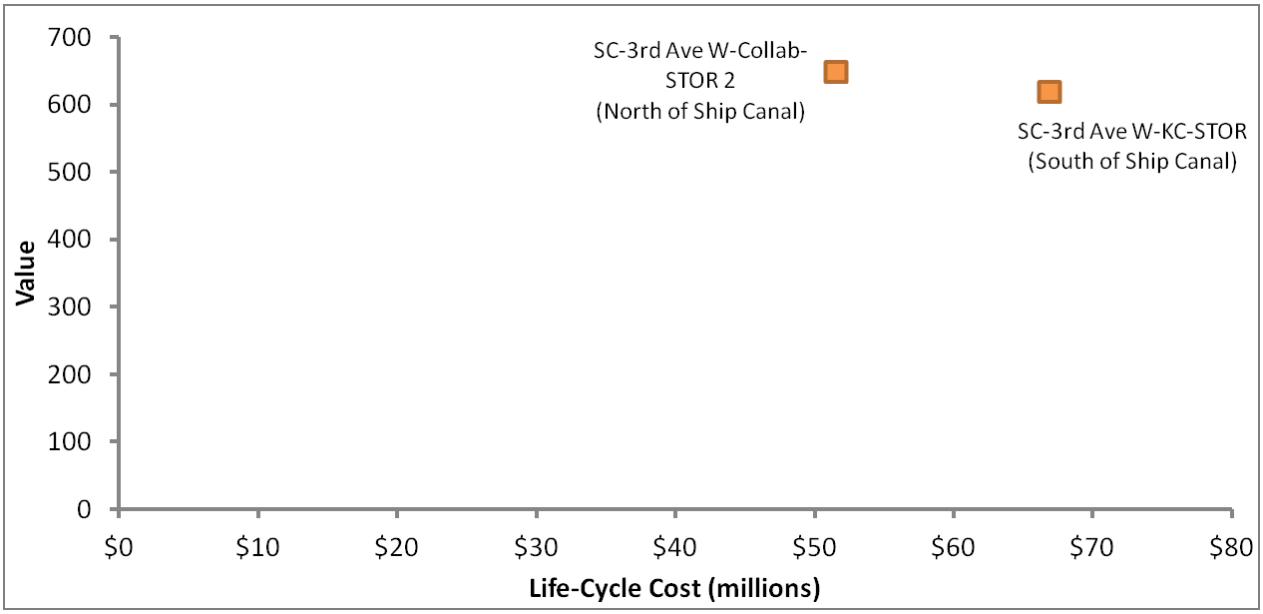

Figure H.3.1-3. Site Alternative Comparison: 3rd Ave W

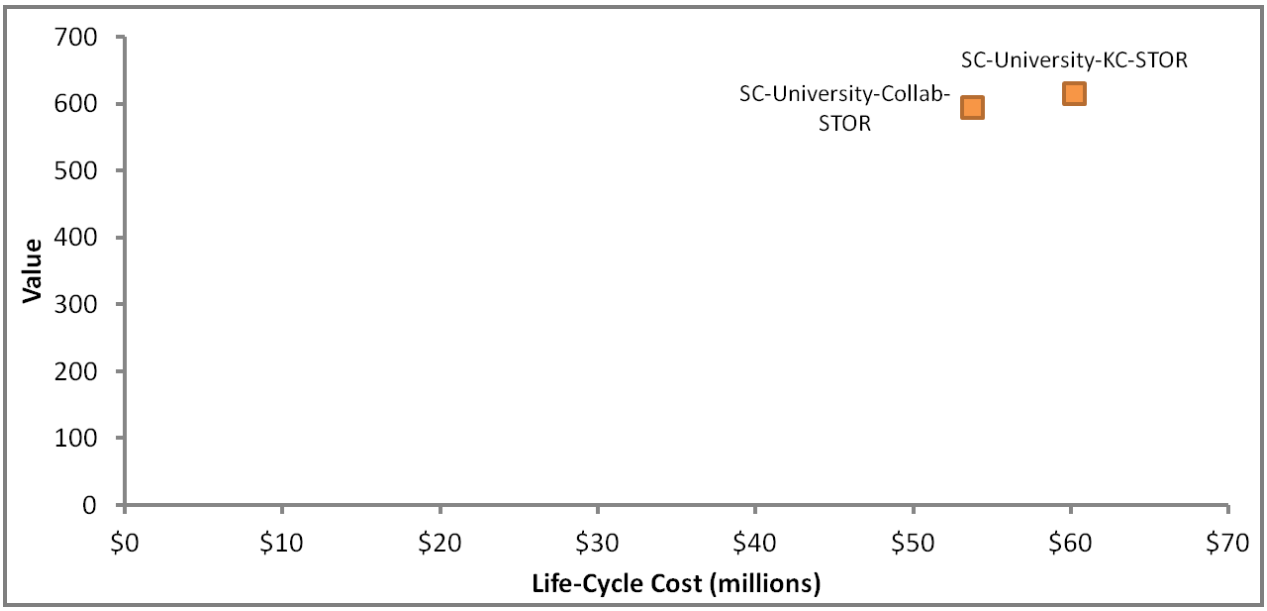

Figure H.3.1-4. Site Alternative Comparison: University

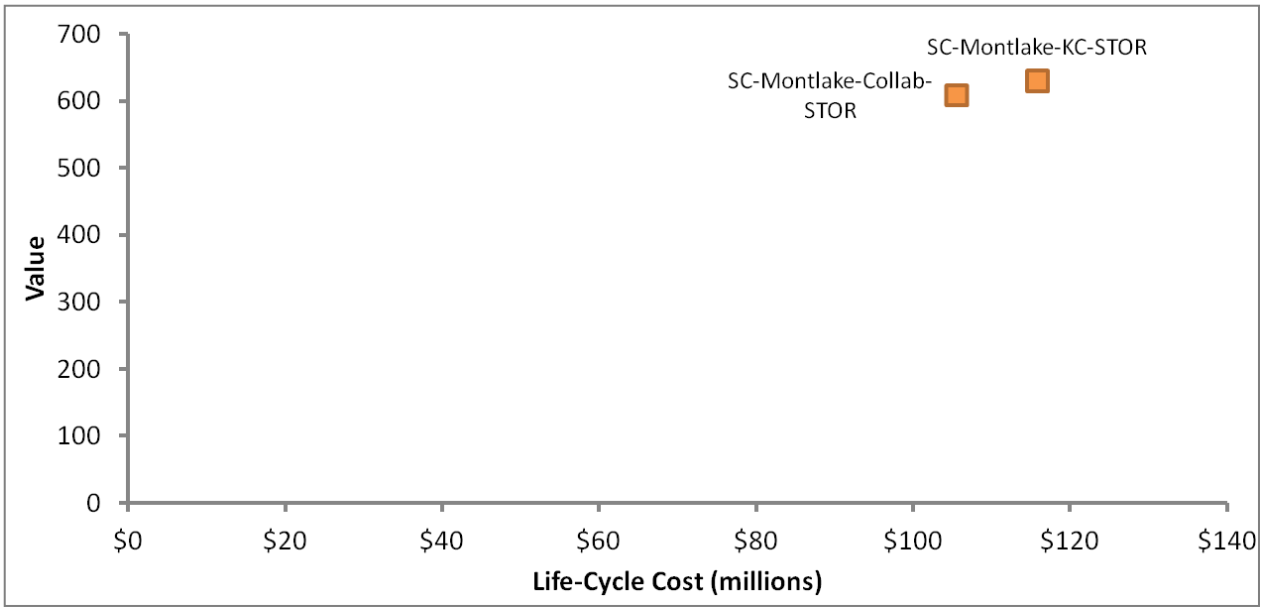

Figure H.3.1-5. Site Alternative Comparison: Montlake

Area Alternative Comparison

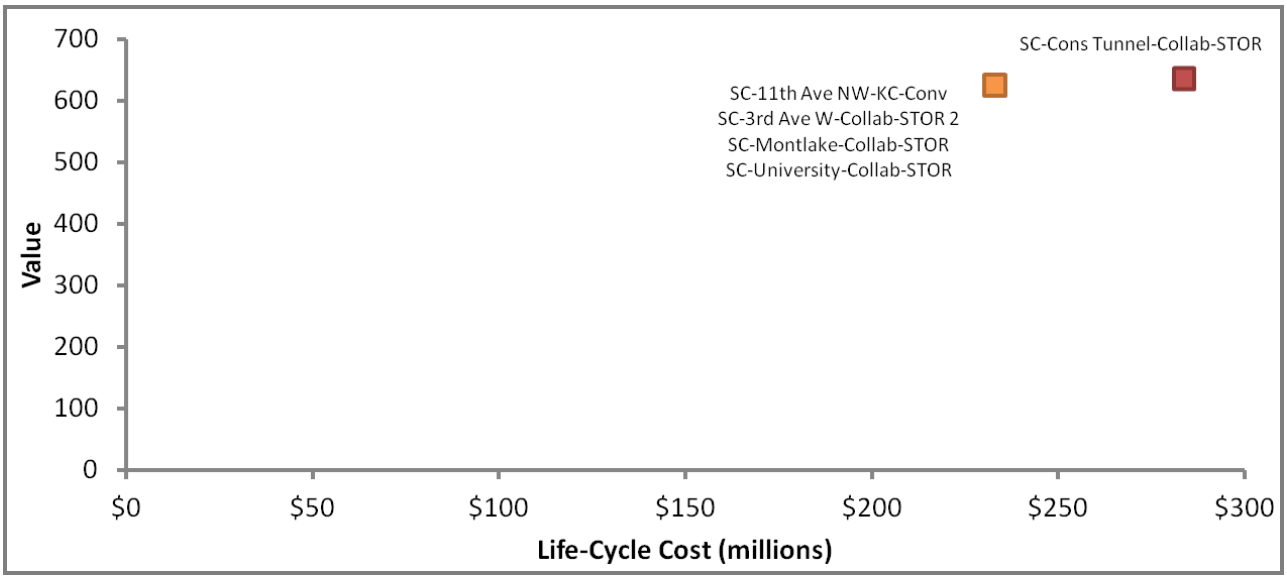

Figure H.3.1-6. Ship Canal: Area Alternative Comparison

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2012 CSO Control Program Review Alternatives Summary

					Total Costs, 2010 Million Dollars						Annual O&M Costs, 2010 Million Dollars		KC Share of Life-Cycle Costs, 2010 Million Dollars		
Area	Tracking Number	Alternative Name	Collaborative/ Development Lead	Description	KC 1-Yr CSO Control Volume (MG) or Peak Flow Rate (MGD), Oct 2010	SPU 1-Yr CSO Control Volume (MG) or Peak Flow Rate, (MGD) 11/17/10	Total Construction Cost[1]	Property and Easement Acquisition Cost	Total Project Cost	KC Share of Total Project Costs	Draft Annual O&M Cost	KC Share of Annual O&M Costs	Life-Cycle Costs (Present Value)	Life-Cycle Costs (Net Equivalent Annual Cost)	TBL: Weighted Value Score
Ship Canal															
	1	SC-11th Ave NW-KC-STOR [DSN004-STOR-1 (KC)]	No	RWSP Alternative. Storage tank to control 11th Ave NW CSOs only.	1.85		$13.03	$3.91	$31.50	$31.50	$0.13	$0.13	$36.06	$1.19	675
	2	SC-11th Ave NW-KC-Conv [DSN004-CON-1 (KC)]	No	Increase conveyance to Ballard Siphon to control 11th Ave NW .	0.3		$11.66	$0.00	$23.70	$23.70	$0.01	$0.01	$22.06	$0.73	670
	3	SC-3rd Ave W-KC-STOR [DSN008-STOR-1 (KC)]	No	RWSP Alternative. South canal storage tank to control 3rd Ave W CSOs only.	4.18		$22.93	$7.58	$56.40	$56.40	$0.28	$0.28	$66.86	$2.21	620
	5	SC-3rd Ave W-Collab-STOR 2 [DSN008-STOR-2 (KC & SPU)]	Yes - SPU	Joint storage upstream of the Fremont Siphon for King County 3rd Ave W and SPU CSO Basins 147 and 174; AKA N-13 Costs shown are for N-13a (Stone Way Tunnel), developed using KC cost estimating methodology.	4.18	3.05	$34.75	$12.58	$86.90	$50.27	$0.36	$0.16	$51.52	$1.70	650
	6	SC-Montlake-KC-STOR [DSN014-STOR-1 (KC)]	No	Storage tank to control Montlake CSOs only	6.6		$41.53	$14.26	$102.80	$102.80	$0.40	$0.40	$115.86	$3.83	630
	7	SC-Montlake-Collab-STOR [DSN014-STOR-2 (KC & SPU)]	Yes - KC	Transfer SPU Leschi, Madison Park, Montlake CSO storage needs to joint facility for King County Montlake CSOs, located on south side of Ship Canal. AKA N-18.	6.6	1.27	$45.17	$16.96	$113.70	$95.35	$0.46	$0.39	$105.51	$3.49	610
	8	SC-University-KC-STOR [DSN015-STOR-1 (KC)]	No	Storage tank to control University CSOs only.	2.94		$22.89	$6.19	$54.50	$54.50	$0.19	$0.19	$60.21	$1.99	615
	10	SC-University-Collab-STOR [DSN015-STOR-4 (KC & SPU)]	Yes - KC	SPU storage tank to control University and SPU CSOs	2.94	2.29	$33.03	$10.36	$80.50	$45.24	$0.41	$0.23	$53.76	$1.78	595
	12	SC-Cons Tunnel-Collab-STOR [DSN004/008/014/015-STOR-1 (KC & SPU)]	Yes - SPU	Joint King County/SPU storage and conveyance tunnel from University Regulator to 3rd Ave W Regulator; AKA Alternative N-3 Costs shown are for N-3a (Tunnel Under Lake Union), developed using KC cost estimating methodology.	15.57	5.875	$162.68	$25.89	$363.70	$237.14	$2.10	$1.22	$283.52	$9.38	635

[1]Total Construction Costs: Alternatives developed by King County include SDOT Street Use Permit fees; property and easement acquisition costs are not included in construction costs. Alternatives developed by SPU include property and easement acquisition costs as well as SDOT Street Use Permit fees.

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Appendix H.3.2

Results of Triple-Bottom-Line Analysis: Middle EBI – Hanford #2, Lander St, Kingdome, and King St

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Summary of Screening Process

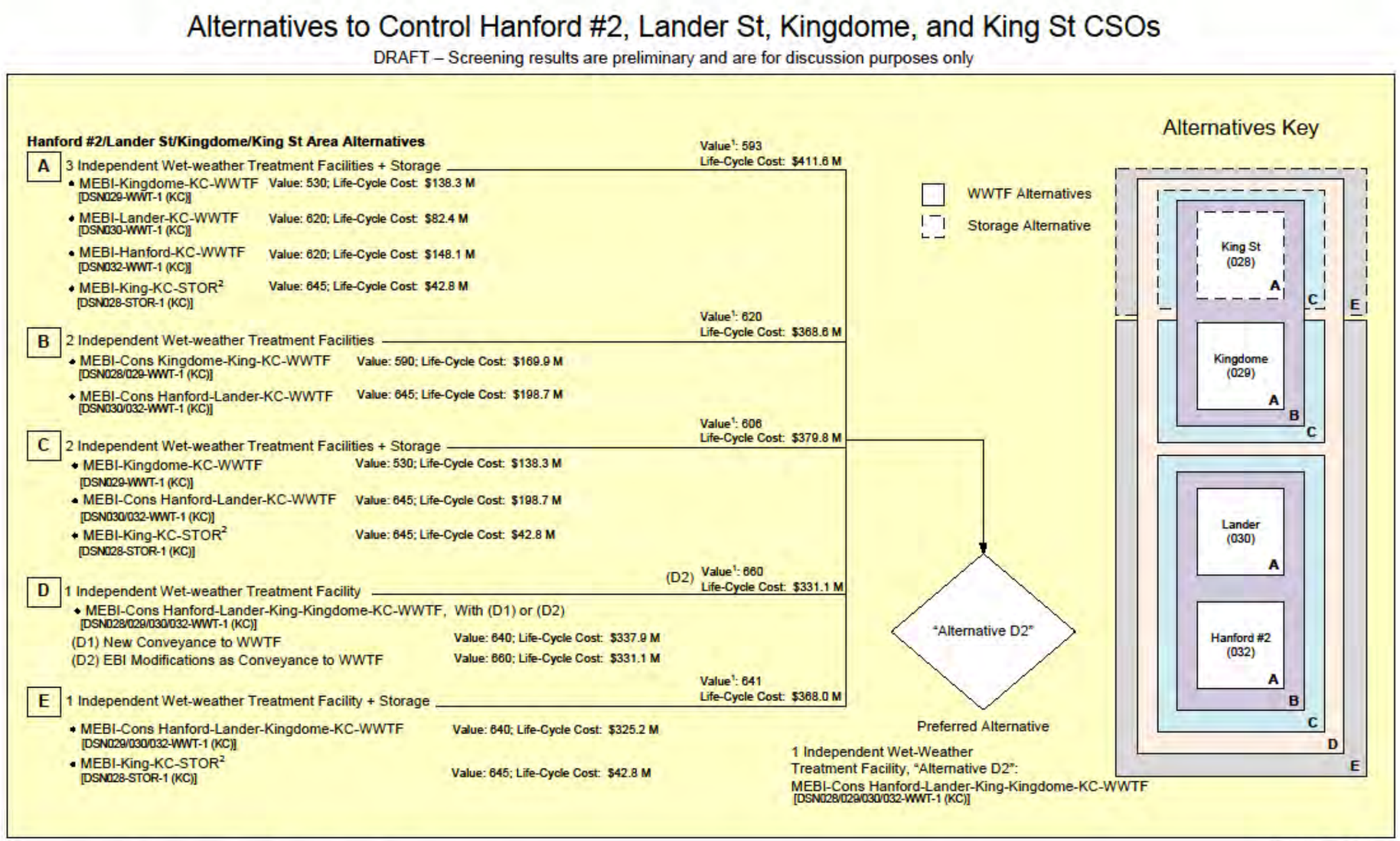

Figure H.3.2-1. Middle EBI: Hanford #2, Lander St, Kingdome, and King St Alternatives Screening Bracket

Area Alternative Comparison

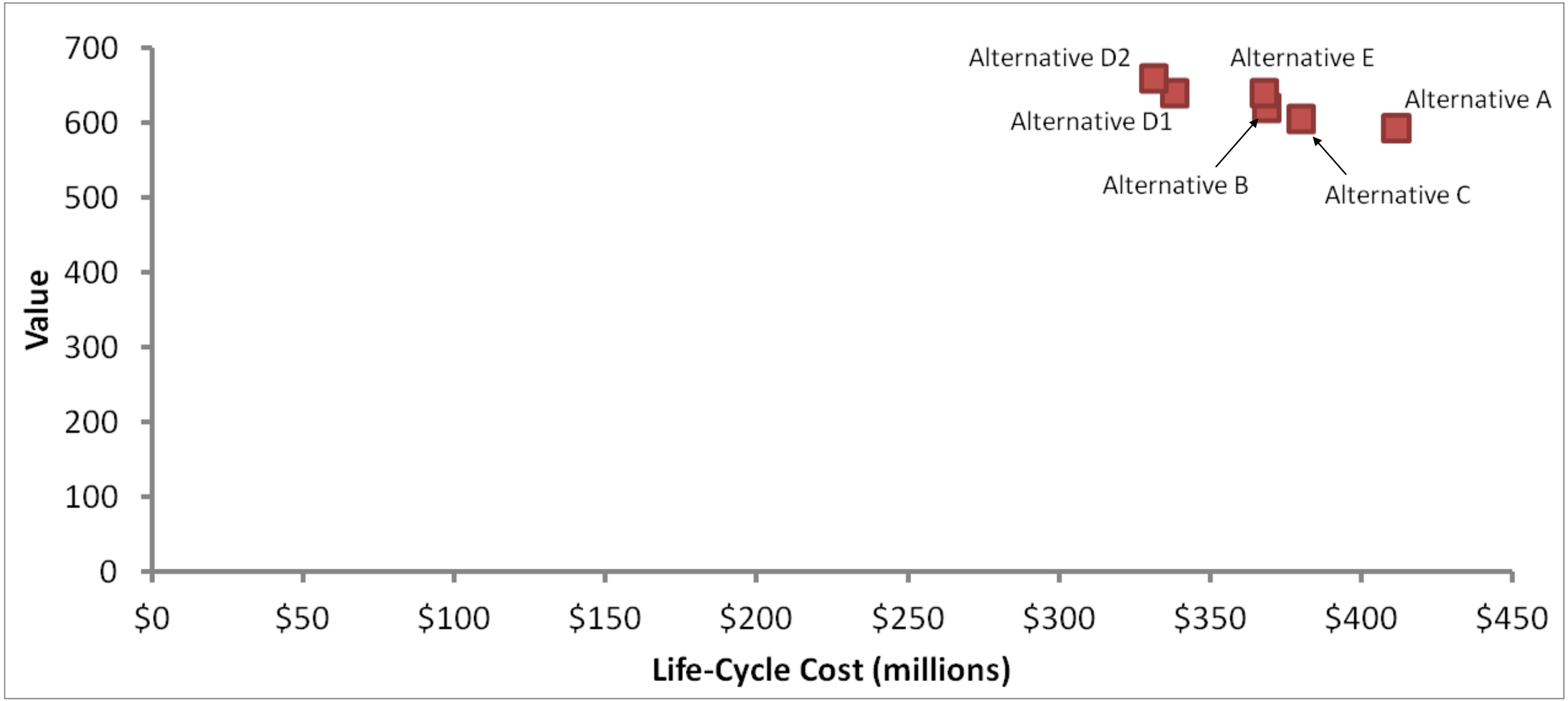

Figure H.3.2-2. Area Alternative Comparison: Middle EBI - Hanford #2, Lander St, Kingdome, and King St

2012 CSO Control Program Review Alternatives Summary

					Wet-Weather Treatment Facility (Ballasted Sedimentation) Design Criteria				Total Costs, 2010 Million Dollars				Annual O&M Costs, 2010 Million Dollars		KC Share of Life-Cycle Costs, 2010 Million Dollars		
Area	Tracking Number	Alternative Number	Collaborative/ Development Lead	Description	KC 1-Yr CSO Control Volume (MG) or Peak Flow Rate (MGD), Oct 2010	SPU 1-Yr CSO Control Volume (MG) or Peak Flow Rate, (MGD) 11/17/10	Design Flow Rate (MGD)	Equalization Basin Volume (MG)	Total Construction Cost[1]	Property and Easement Acquisition Cost	Total Project Cost	KC Share of Total Project Costs	Draft Annual O&M Cost	KC Share of Annual O&M Costs	Life-Cycle Costs (Present Value)	Life-Cycle Costs (Net Equivalent Annual Cost)	TBL: Weighted Value Score
Middle EBI - Hanford #2, Lander, Kingdome, and King Street																	
	32	MEBI-King-KC-STOR [DSN028-STOR-1 (KC)]	No - does include small flow transfers from SPU	Storage for King Street CSOs only	2.63		N/A	N/A	$16.43	$4.14	$38.70	$38.70	$0.13	$0.13	$42.76	$1.41	645
	35	MEBI-Kingdome-KC-WWTF [DSN029-WWT-1 (KC)]	No - does include small flow transfers from SPU	Wet-weather treatment facility to control Kingdome CSOs only. Costs shown are for ballasted sedimentation.	87		48	0.87	$47.20	$9.51	$108.20	$108.20	$0.72	$0.72	$138.30	$4.57	530
	36	MEBI-Cons Kingdome-King-KC-WWTF [DSN028/029-WWT-1 (KC)]	No - does include small flow transfers from SPU	RWSP: Wet-weather treatment facility to control King St and Kingdome CSOs only. Costs shown are for ballasted sedimentation.	116.6		56	1.45	$59.39	$10.38	$134.10	$134.10	$0.87	$0.87	$169.87	$5.62	590
	37	MEBI-Lander-KC-WWTF [DSN030-WWT-1 (KC)]	No	Wet-weather treatment facility to control Lander CSOs only Costs shown are for ballasted sedimentation.	47.9		23	0.79	$31.93	$8.31	$75.70	$75.70	$0.50	$0.50	$82.44	$2.73	620
	38	MEBI-Hanford-KC-WWTF [DSN032-WWT-1 (KC)]	No - does include small flow transfers from SPU	Wet-weather treatment facility to control Hanford #2 CSOs only Costs shown are for ballasted sedimentation.	94.9		68	0.94	$52.29	$9.18	$118.10	$118.10	$0.74	$0.74	$148.10	$4.90	620
	39	MEBI-Cons Hanford-Lander-KC-WWTF [DSN030/032-WWT-1 (KC)]	No - does include small flow transfers from SPU	Wet-weather treatment facility to control Hanford #2 & Lander CSOs only Costs shown are for ballasted sedimentation.	142.8		94	0.97	$72.20	$10.05	$159.70	$159.70	$0.97	$0.97	$198.72	$6.57	645
	40	MEBI-Cons Hanford-Lander-Kingdome-KC-WWTF [DSN029/030/032-WWT-1 (KC)]	No - does include small flow transfers from SPU	Wet-weather treatment facility to control Hanford #2, Lander, and Kingdome CSOs. Costs shown are for ballasted sedimentation and for the new **conveyance** option.	229.8		139	1.57	$124.32	$12.07	$268.20	$268.20	$1.47	$1.47	$325.19	$10.75	640
	41A	MEBI-Cons Hanford-Lander-King-Kingdome-KC-WWTF [DSN028/029/030/032-WWT-1 (KC)]	No - does include small flow transfers from SPU	Wet-weather treatment facility to control Hanford #2, Lander, Kingdome, and King Street CSOs. Costs shown are for ballasted sedimentation and for the new **conveyance** option.	259.4		151	1.71	$136.14	$12.88	$293.20	$293.20	$1.28	$1.28	$337.94	$11.18	640
	41B	MEBI-Cons Hanford-Lander-King-Kingdome-KC-WWTF [DSN028/029/030/032-WWT-1 (KC)]	No - does include small flow transfers from SPU	Wet-weather treatment facility to control Hanford #2, Lander, Kingdome, and King Street CSOs. Costs shown are for ballasted sedimentation and for the **backflowing** the EBI option.	259.4		151	1.71	$124.74	$13.47	$270.80	$270.80	$1.53	$1.53	$331.11	$10.95	660

[1]Total Construction Costs: Alternatives developed by King County include SDOT Street Use Permit fees; property and easement acquisition costs are not included in construction costs. Alternatives developed by SPU include property and easement acquisition costs as well as SDOT Street Use Permit fees.

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Appendix H.3.3

Results of Triple-Bottom-Line Analysis: Middle EBI – Hanford #1 (Hanford@Rainier)

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Summary of Screening Process

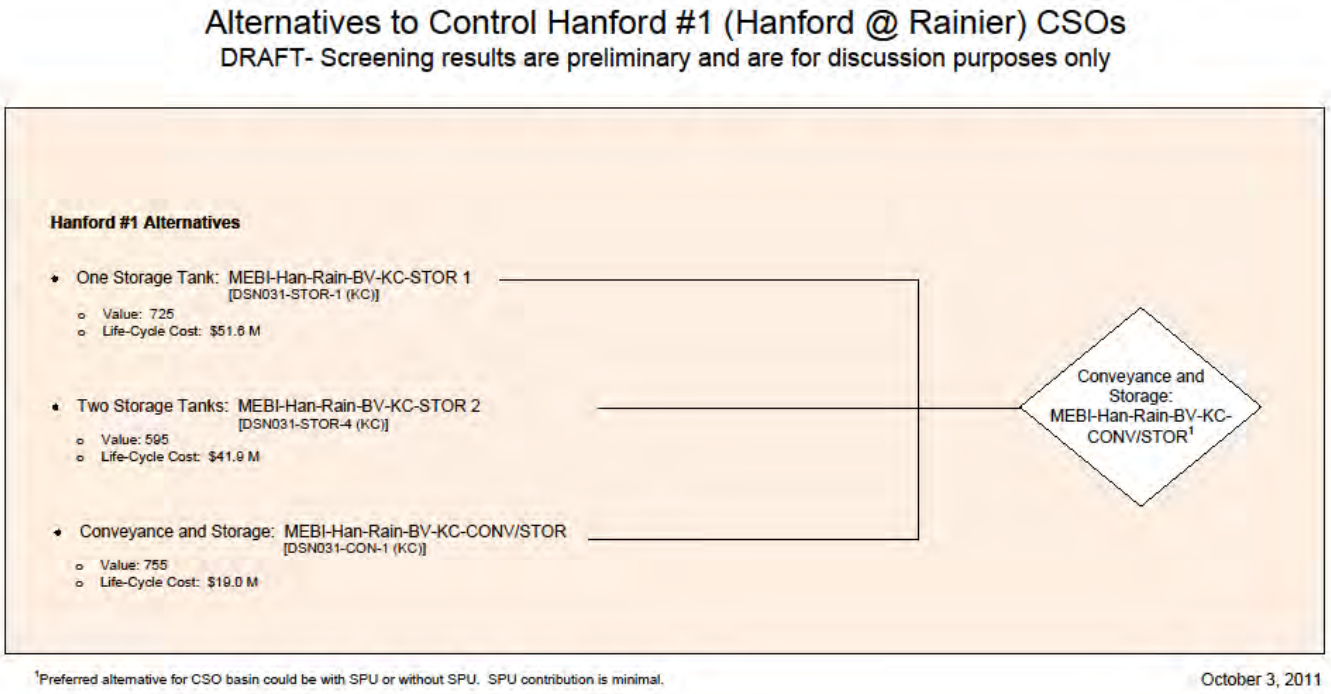

Figure H.3.3-1. Middle EBI: Hanford #1 (Hanford @ Rainier) Alternatives Screening Bracket

Area Alternative Comparison

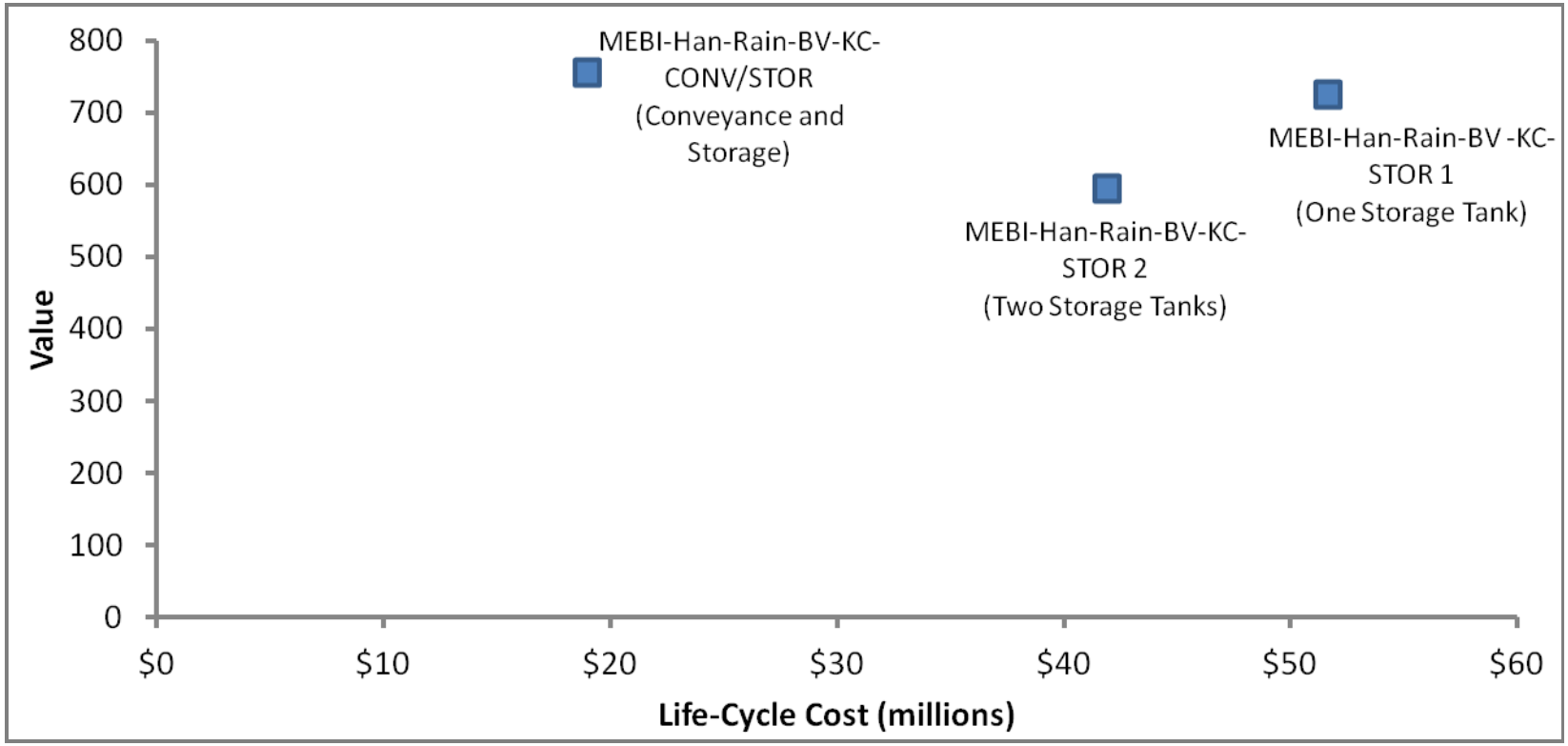

Figure H.3.3-2: Area Alternative Comparison: Middle EBI – Hanford #1 (Hanford @ Rainier)

2012 CSO Control Program Review Alternatives Summary

Area	Tracking Number	Alternative Number	Collaborative/ Development Lead	Description	KC 1-Yr CSO Control Volume (MG) or Peak Flow Rate (MGD), Oct 2010	SPU 1-Yr CSO Control Volume (MG) or Peak Flow Rate, (MGD) 11/17/10	Total Costs, 2010 Million Dollars: Total Construction Cost[1]	Property and Easement Acquisition Cost	Total Project Cost	KC Share of Total Project Costs	Annual O&M Costs, 2010 Million Dollars: Draft Annual O&M Cost	KC Share of Annual O&M Costs	KC Share of Life-Cycle Costs, 2010 Million Dollars: Life-Cycle Costs (Present Value)	Life-Cycle Costs (Net Equivalent Annual Cost)	TBL: Weighted Value Score
Middle EBI - Hanford #1 (Hanford@Rainier)															
	43	MEBI-Han-Rain-BV -KC-STOR 1 [DSN031-STOR-1 (KC)]	No	One storage tank to control Hanford #1 (Hanford @ Rainier) and Bayview N CSOs only	1.79		$23.24	$2.58	$50.50	$50.50	$0.10	$0.10	$51.59	$1.71	725
	44	MEBI-Han-Rain-BV-KC-STOR 2 [DSN031-STOR-4 (KC)]	No	Two storage tanks to control Hanford #1 (Hanford @ Rainier) and Bayview N CSOs only	1.79		$17.66	$2.91	$39.60	$39.60	$0.10	$0.10	$41.86	$1.38	595
	47	MEBI-Han-Rain-BV-KC-CONV/STOR [DSN031-CON-1 (KC)]	No	Conveyance improvements to send more flow to Bayview Tunnel with reduced storage volume at Hanford@Rainier.	0.343		$8.63	$0.91	$19.20	$19.20	$0.03	$0.03	$18.99	$0.63	755

[1]Total Construction Costs: Alternatives developed by King County include SDOT Street Use Permit fees; property and easement acquisition costs are not included in construction costs. Alternatives developed by SPU include property and easement acquisition costs as well as SDOT Street Use Permit fees.

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Appendix H.3.4

Results of Triple-Bottom-Line Analysis: South EBI – S Michigan St and Brandon St

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Summary of Screening Process

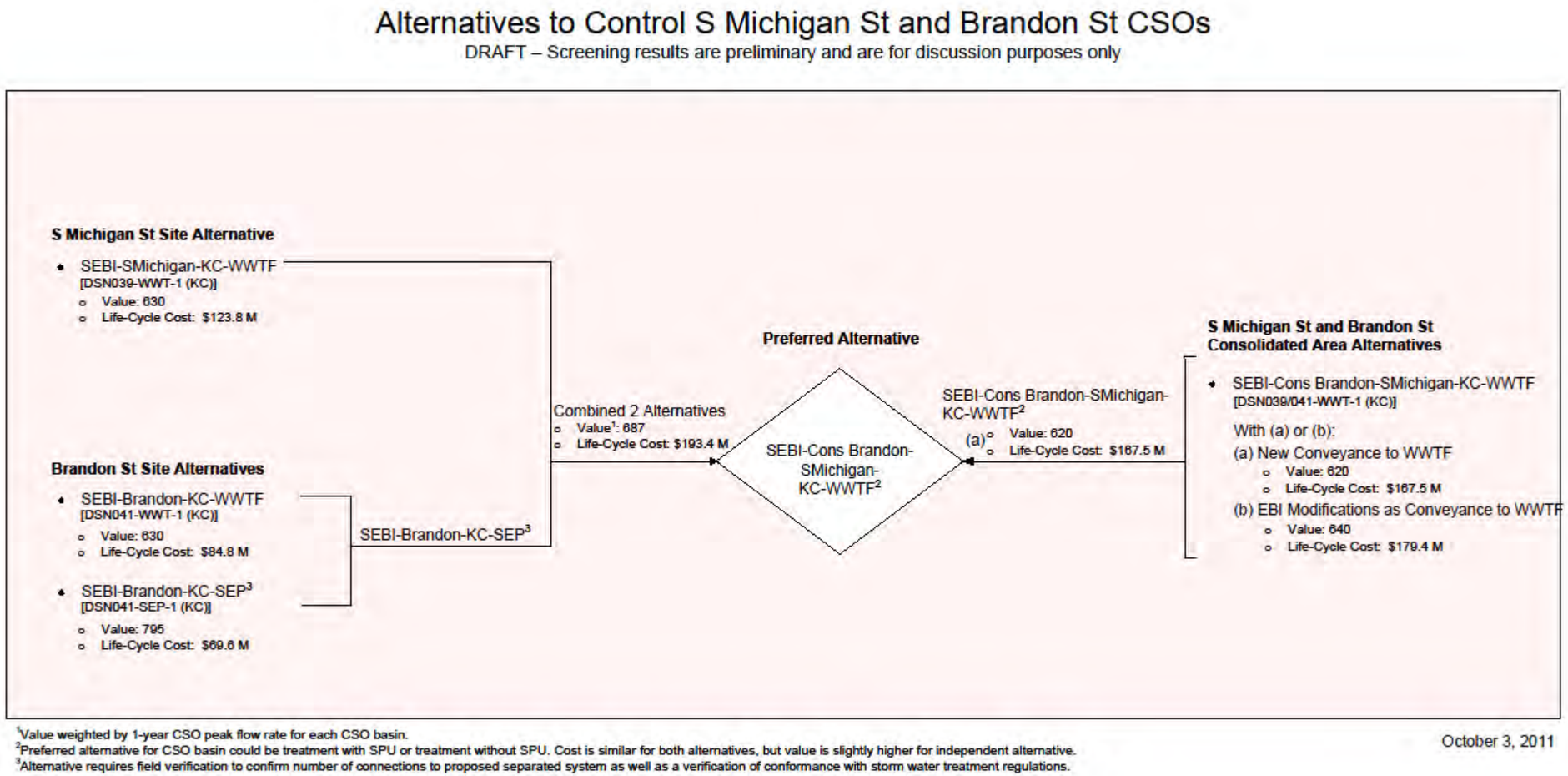

Figure H.3.4-1. South EBI: S Michigan St and Brandon St Alternatives Screening Bracket

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Site Alternative Comparison

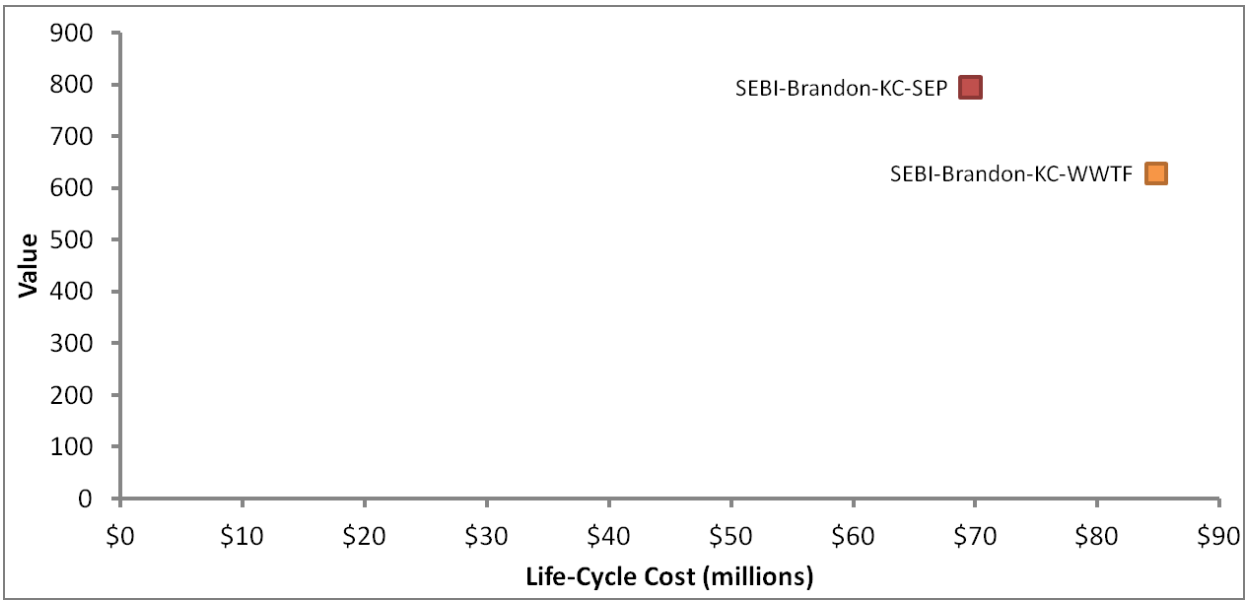

Figure H.3.4-2. Site Alternative Comparison: Brandon St

Area Alternative Comparison

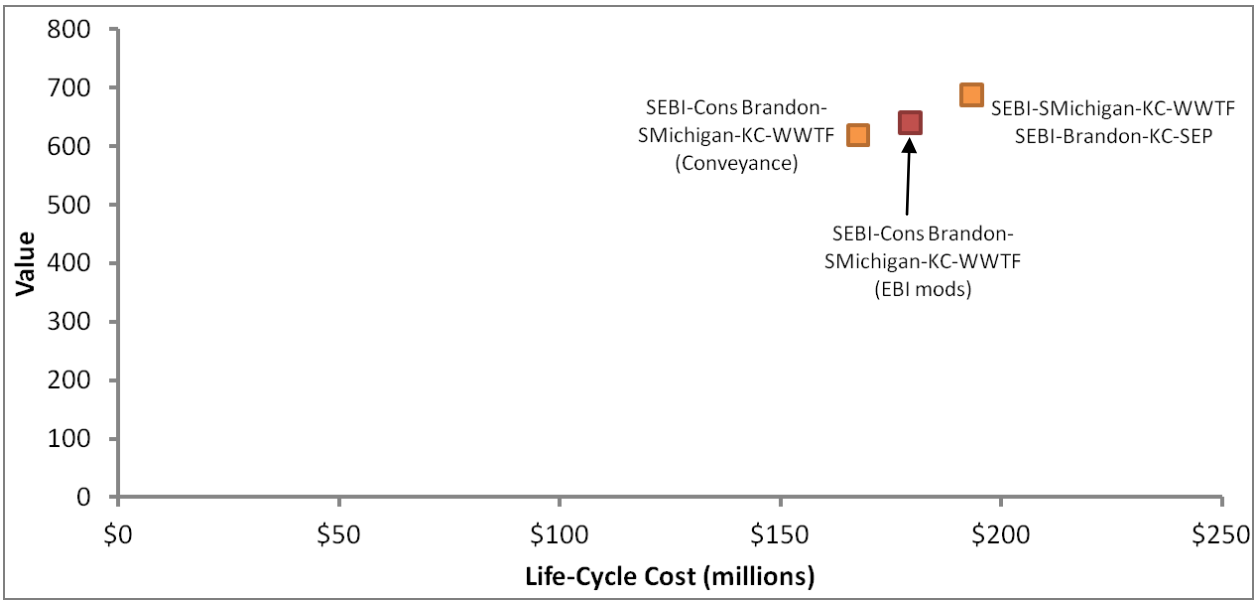

Figure H.3.4-3. Area Alternative Comparison: South EBI – S Michigan St and Brandon St

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2012 CSO Control Program Review Alternatives Summary

Area	Tracking Number	Alternative Number	Collaborative/ Development Lead	Description	Wet-Weather Treatment Facility (Ballasted Sedimentation) Design Criteria: KC 1-Yr CSO Control Volume (MG) or Peak Flow Rate (MGD), Oct 2010	Wet-Weather Treatment Facility (Ballasted Sedimentation) Design Criteria: SPU 1-Yr CSO Control Volume (MG) or Peak Flow Rate, (MGD) 11/17/10	Wet-Weather Treatment Facility (Ballasted Sedimentation) Design Criteria: Design Flow Rate (MGD)	Wet-Weather Treatment Facility (Ballasted Sedimentation) Design Criteria: Equalization Basin Volume (MG)	Total Costs, 2010 Million Dollars: Total Construction Cost[1]	Total Costs, 2010 Million Dollars: Property and Easement Acquisition Cost	Total Costs, 2010 Million Dollars: Total Project Cost	Total Costs, 2010 Million Dollars: KC Share of Total Project Costs	Annual O&M Costs, 2010 Million Dollars: Draft Annual O&M Cost	Annual O&M Costs, 2010 Million Dollars: KC Share of Annual O&M Costs	KC Share of Life-Cycle Costs, 2010 Million Dollars: Life-Cycle Costs (Present Value)	KC Share of Life-Cycle Costs, 2010 Million Dollars: Life-Cycle Costs (Net Equivalent Annual Cost)	TBL: Weighted Value Score
South EBI																	
	49	SEBI-SMichigan-KC-WWTF [DSN039-WWT-1 (KC)]	No	RWSP Alternative. Wet-weather treatment facility to control Michigan CSOs only. Costs shown are for ballasted sedimentation.	66.1		40	0.86	$41.58	$8.65	$95.70	$95.70	$0.67	$0.67	$123.84	$4.10	630
	51	SEBI-Brandon-KC-WWTF [DSN041-WWT-1 (KC)]	No	RWSP Alternative. Wet-weather treatment to control Brandon CSOs only. Costs shown are for ballasted sedimentation.	35.2		24	0.41	$27.24	$7.68	$65.30	$65.30	$0.46	$0.46	$84.77	$2.80	630
	52	SEBI-Brandon-KC-SEP [DSN041-SEP-1 (KC)]	No	Brandon Area Sewer Separation	6.52		N/A	N/A	$34.19	$1.78	$71.70	$71.70	$0.07	$0.07	$69.56	$2.30	795
	53A	SEBI-Cons Brandon-SMichigan-KC-WWTF [DSN039/041-WWT-1 (KC)]	No	Wet-weather treatment facility to control Michigan & Brandon CSOs only. Costs shown are for ballasted sedimentation and for the new **conveyance** option.	101.3		66	0.89	$62.62	$9.65	$139.70	$139.70	$0.73	$0.73	$167.51	$5.54	620
	53B	SEBI-Cons Brandon-SMichigan-KC-WWTF [DSN039/041-WWT-1 (KC)]	No	Wet-weather treatment facility to control Michigan & Brandon CSOs only. Costs shown are for ballasted sedimentation and for the **backflowing the EBI** option.	35.2		24	0.41	$66.45	$10.23	$148.30	$148.30	$0.80	$0.80	$179.42	$5.93	640

[1]Total Construction Costs: Alternatives developed by King County include SDOT Street Use Permit fees; property and easement acquisition costs are not included in construction costs. Alternatives developed by SPU include property and easement acquisition costs as well as SDOT Street Use Permit fees.

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Appendix H.3.5

Results of Triple-Bottom-Line Analysis: West Duwamish – W Michigan St and Terminal 115

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Summary of Screening Process

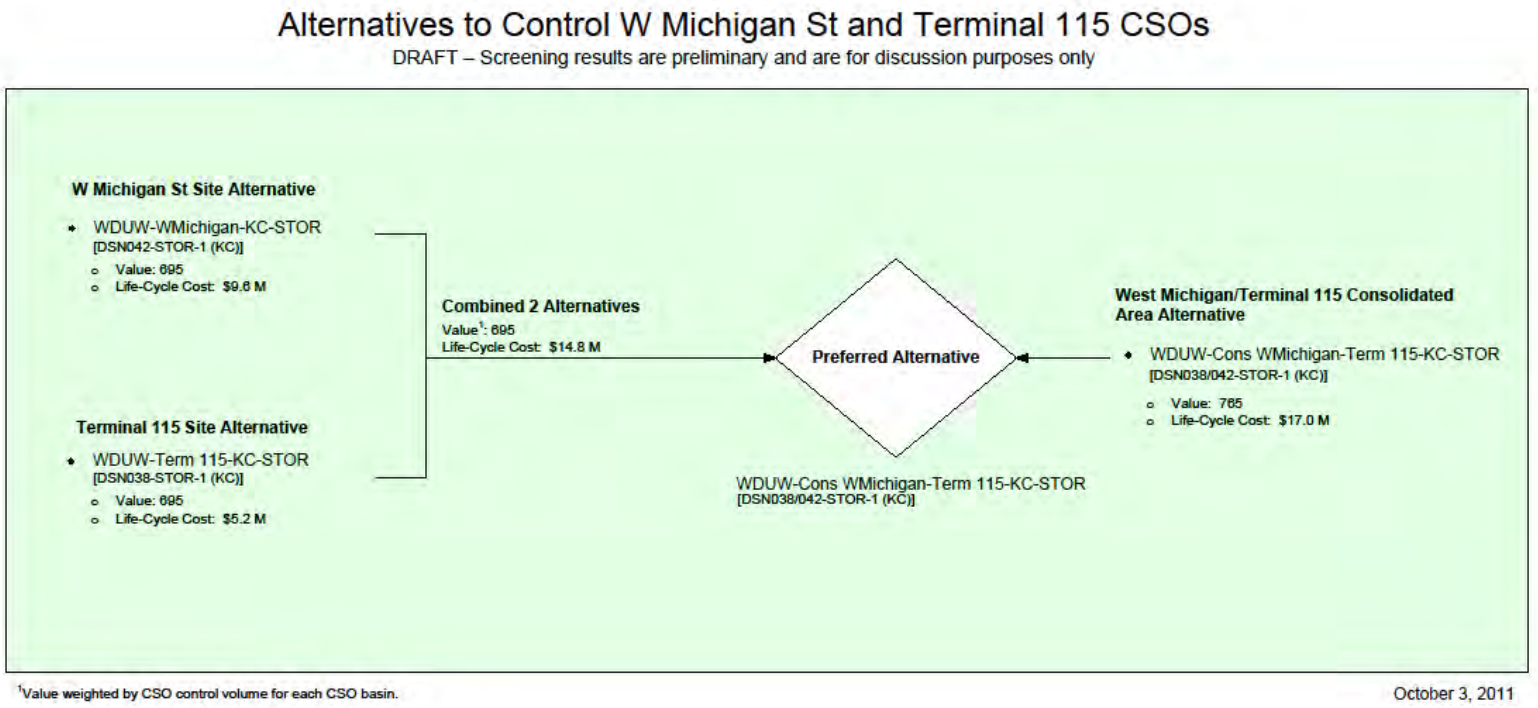

Figure H.3.5-1. West Duwamish: W Michigan St and Terminal 115 Alternatives Screening Bracket

Area Alternative Comparison

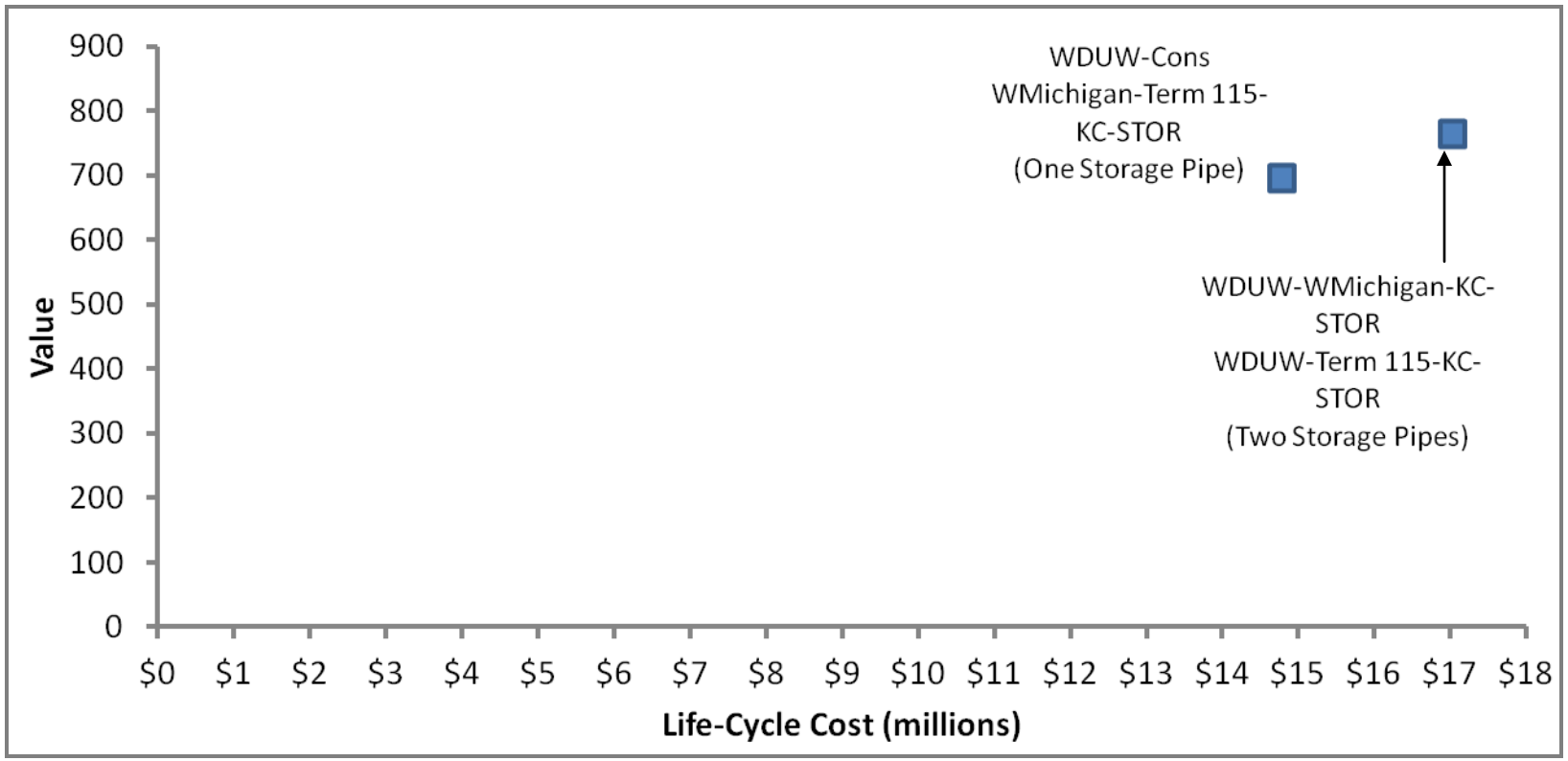

Figure H.3.5-2. Area Alternative Comparison: West Duwamish – W Michigan St and Terminal 115

2012 CSO Control Program Review Alternatives Summary

					Total Costs, 2010 Million Dollars						Annual O&M Costs, 2010 Million Dollars		KC Share of Life-Cycle Costs, 2010 Million Dollars		
Area	Tracking Number	Alternative Number	Collaborative/ Development Lead	Description	KC 1-Yr CSO Control Volume (MG) or Peak Flow Rate (MGD), Oct 2010	SPU 1-Yr CSO Control Volume (MG) or Peak Flow Rate, (MGD) 11/17/10	Total Construction Cost[1]	Property and Easement Acquisition Cost	Total Project Cost	KC Share of Total Project Costs	Draft Annual O&M Cost	KC Share of Annual O&M Costs	Life-Cycle Costs (Present Value)	Life-Cycle Costs (Net Equivalent Annual Cost)	TBL: Weighted Value Score
West Duwamish - Terminal 115 and W Michigan St															
	57	WDUW-WMichigan-KC-STOR [DSN042-STOR-1 (KC)]	No	Storage to control W Michigan CSOs only.	0.27		$3.18	$0.20	$7.10	$7.10	$0.06	$0.06	$9.58	$0.32	695
	58	WDUW-Term 115-KC-STOR [DSN038-STOR-1 (KC)]	No	Storage to control Terminal 115 CSOs only.	0.05		$1.25	$0.19	$2.90	$2.90	$0.05	$0.05	$5.19	$0.17	695
	59	WDUW-Cons WMichigan-Term 115-KC-STOR [DSN038/042-STOR-1 (KC)]	No	Storage to control W Michigan and Terminal 115 CSOs only.	0.32		$6.94	$0.19	$14.80	$14.80	$0.06	$0.06	$17.01	$0.56	765

[1]Total Construction Costs: Alternatives developed by King County include SDOT Street Use Permit fees; property and easement acquisition costs are not included in construction costs. Alternatives developed by SPU include property and easement acquisition costs as well

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Appendix H.3.6

Results of Triple-Bottom-Line Analysis: West Duwamish – Chelan Ave

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Summary of Screening Process

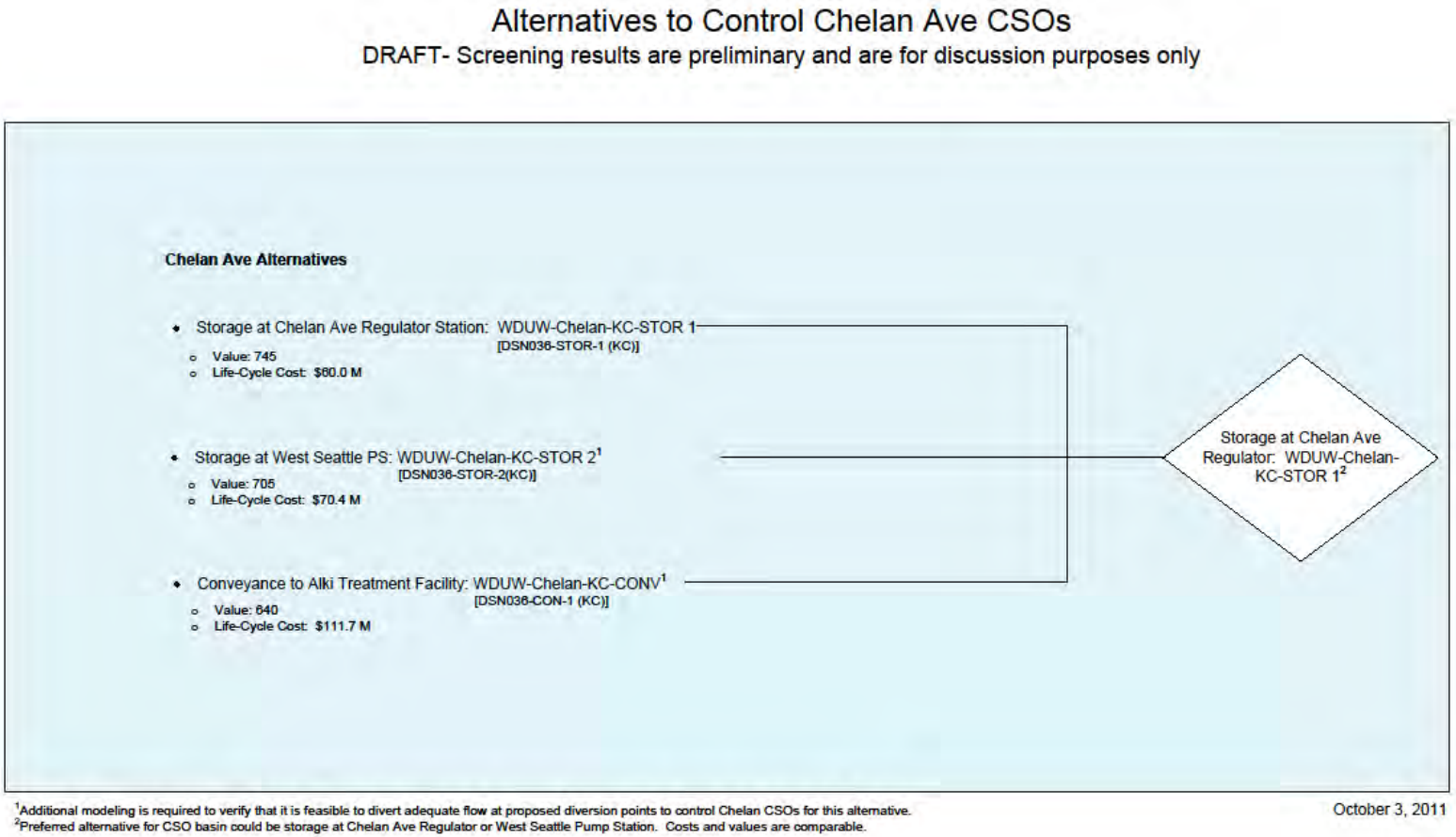

Figure H.3.6-1. West Duwamish: Chelan Ave Alternatives Screening Bracket

Area Alternative Comparison

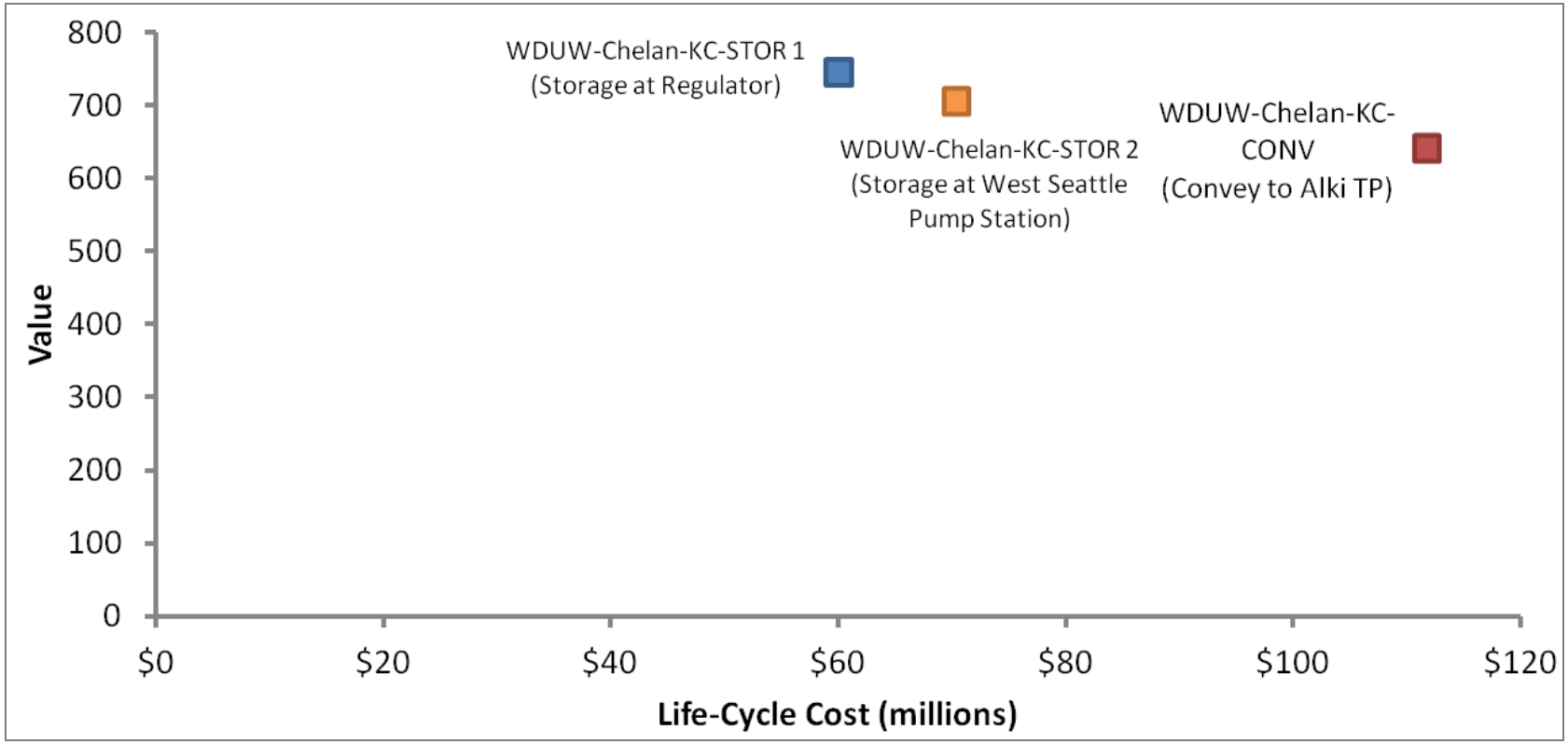

Figure H.3.6-2. Area Alternative Comparison: West Duwamish – Chelan Ave

2012 CSO Control Program Review Alternatives Summary

					Total Costs, 2010 Million Dollars						Annual O&M Costs, 2010 Million Dollars		KC Share of Life-Cycle Costs, 2010 Million Dollars		
Area	Tracking Number	Alternative Number	Collaborative/ Development Lead	Description	KC 1-Yr CSO Control Volume (MG) or Peak Flow Rate (MGD), Oct 2010	SPU 1-Yr CSO Control Volume (MG) or Peak Flow Rate, (MGD) 11/17/10	Total Construction Cost[1]	Property and Easement Acquisition Cost	Total Project Cost	KC Share of Total Project Costs	Draft Annual O&M Cost	KC Share of Annual O&M Costs	Life-Cycle Costs (Present Value)	Life-Cycle Costs (Net Equivalent Annual Cost)	TBL: Weighted Value Score
West Duwamish - Chelan Ave															
	54	WDUW-Chelan-KC-STOR 1 [DSN036-STOR-1 (KC)]	No	Storage to control Chelan CSOs only, located in vicinity of Chelan Ave Regulator	3.85		$22.33	$4.90	$51.70	$51.70	$0.24	$0.24	$60.03	$1.99	745
	55	WDUW-Chelan-KC-STOR 2 [DSN036-STOR-2 (KC)]	No	Storage to control Chelan CSOs only, located at West Seattle Pump Station site.	3.85		$26.74	$0.00	$54.30	$54.30	$0.38	$0.38	$70.38	$2.33	705
	56	WDUW-Chelan-KC-CONV [DSN036-CON-1 (KC)]	No	Transfer Chelan and Harbor CSOs to Alki Tunnel and Wet Weather Treatment Plant.	45.7		$42.42	$0.00	$86.10	$86.10	$0.61	$0.61	$111.67	$3.69	640

[1]Total Construction Costs: Alternatives developed by King County include SDOT Street Use Permit fees; property and easement acquisition costs are not included in construction costs. Alternatives developed by SPU include property and easement acquisition costs as well

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