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RE: **Technical Memorandum 9B – Approach to Incorporating Cost Risk into the Economic Model - FINAL**

1.0 INTRODUCTION

The City of Hillsboro (City) is evaluating long term water supply options that will deliver 80 million gallons per day (mgd) of additional treated water for itself and its Joint Water Commission (JWC) partners. As part of that effort, a long-term (50-year) economic model of the options is being developed to evaluate the net present value (NPV) of each option.

Significant effort has been made to define the individual options and develop capital and operations and maintenance (O&M) cost estimates, as described in Technical Memorandum (TM) 9A. Given that the projects are in an early stage of concept or design, many assumptions were required to develop these estimates. Assumptions are consistent among the various supply options, to the degree practical.

The actual cost of a project will differ from the estimate for the project. The cost estimator's goal is for the actual bid for the identified scope of work to be equal to or lower than the estimate 95 percent of the time. The actual cost of construction will differ from the estimate due to changes in bidding climate and changes in scope. This TM describes the approach used to incorporate cost risk into the economic model.¹

The evaluations described in this TM were presented at the January 24, 2012 Technical Advisory Committee meeting. This final version of the TM incorporates comments from that meeting.

2.0 COST RISK DEFINITIONS

Each water supply option includes capital projects that may include wells, dam construction, raw water intake and pumping, water treatment, booster pumping, reservoir storage, and raw and finished water pipelines. All of the capital projects considered as part of the options analysis have a risk of the actual implementation costs being greater or less than anticipated costs ("cost risk"). Those cost risks vary among the different types of projects. For the projects under consideration in this evaluation, it is assumed that the overall cost risk varies due to two main factors: project-type cost risk and design-completion cost risk. Table 1 provides definitions of the types of cost risk being used for this evaluation.

¹ It is acknowledged that there are many other types of project risks other than cost (e.g., schedule, ability to acquire water rights). These other risks will be evaluated in TM 10 as part of the overall evaluation of the options and are not assessed here.

Project-type Cost Risk	Intended to capture the fact that some types of projects have an inherently higher risk of actual costs differing from estimated costs. For this evaluation, <i>project-type cost risk</i> is the inherent risk associated with each project type based on a planning level of design. For example, water treatment plant projects on existing sites have a low inherent risk because the site is already secured and conditions are well understood. Whereas dams have a high inherent risk, being vulnerable to significant unknowns such as rock availability.
Design-completion Cost Risk	Intended to capture the fact that some projects are further along in the design process, with projects ranging from conceptual to pre-design level of completion. It is assumed that projects at a lower level of design completion have a higher risk of future cost increases.
Overall Cost Risk	Combination of the previous two factors, intended to capture the overall risk of future costs differing from current estimates.

3.0 PROJECT-TYPE COST RISK

Project-type cost risks were evaluated for each project type included in the options. Each project type was assigned a rating of low, medium, or high cost risk. The evaluation is summarized in Table 2.

Project Type	Preliminary evaluation of project-level risk
Wells	Medium
Dam construction	High
Raw intake and pumping	
Tualatin River	High
Willamette River (Existing)	Low
Willamette River (New)	Medium
Water Treatment Plant	
Existing site	Low
New site (no site yet identified)	Medium
Reverse osmosis facility with brine disposal	High
Booster Pump Stations	Low
20 MG Reservoir	
Existing site	Low
No site identified	Medium

Table 2. Assessment of project-type cost risk based on projects being at a planning level of design.	
Project Type	Preliminary evaluation of project-level risk
Pipelines	
Anticipated average conditions	Medium
Anticipated challenging conditions (difficult traverse or heavily urbanized)	High

4.0 DESIGN-COMPLETION COST RISK

Design-completion cost risks were evaluated for each individual project included in the options. Each project was assigned a level of design completion as follows:

- Conceptual – Assigned to projects for which no planning study has yet been completed.
- Planning – Assigned to projects for which a planning study has been completed.
- Pre-design – Assigned to projects for which preliminary design has been completed.

The evaluations of design-completion cost risk are summarized in Table 3.

5.0 OVERALL COST RISK

Overall cost risks were then evaluated for each individual project included in the options analysis, based on a combination of the project-type and design-completion cost risks and engineering judgment. The evaluations of overall cost risk are presented in Table 4. For each project, the table shows the overall cost risk in bold text, as well as the project-type and design-completion cost risks in parentheses.



Table 3. Assessment of design-completion cost risk

Component	TBWSP	Willamette - Wilsonville	Portland Supply	Newberg West	Newberg East	Northern Groundwater
Wells	N/A	N/A	N/A	N/A	N/A	Conceptual
Dam construction ⁽¹⁾	Planning	Conceptual	Conceptual	Conceptual	Conceptual	Conceptual
Raw intake and pumping	Planning	Pre-design	N/A	Conceptual	Conceptual	N/A
Water treatment facilities	Conceptual	Planning	Conceptual	Conceptual	Conceptual	Conceptual
Booster pump stations	Conceptual	Conceptual	Conceptual	Conceptual	Conceptual	Conceptual
20 MG reservoir	Conceptual	Conceptual	Conceptual	Conceptual	Conceptual	Conceptual
Pipelines	Conceptual	Planning	Conceptual	Conceptual	Conceptual	Conceptual

¹ Dam construction associated with the TBWSP option is the 40-foot dam raise. Dam construction associated with the remaining options is the smaller dam raise project to provide water for Clean Water Services. This smaller dam raise would raise the water surface by 12.5 feet if the dam is reconstructed at its current location or 7.5 feet if a new dam is constructed downstream.

Component	Overall Cost Risk (Project-type Cost Risk/Design-completion Cost Risk)^{1,2}					
	TBWSP	Willamette – Wilsonville	Portland Supply	Newberg West	Newberg East	Northern Groundwater
Wells	N/A	N/A	N/A	N/A	N/A	Medium (M/C)
Dam construction ³	High (H/PL)	High (H/C)	High (H/C)	High (H/C)	High (H/C)	High (H/C)
Raw intake and pumping	High (H/PL)	Low (L/PD)	N/A	Medium (M/C)	Medium (M/C)	N/A
Water treatment facilities	Low (L/C)	Low (L/PL)	Medium (M/C)	Medium (M/C)	Medium (M/C)	High (H/C)
Booster pump stations	Low (L/C)	Low (L/C)	Low (L/C)	Low (L/C)	Low (L/C)	Low (L/C)
20 MG reservoir	Medium (M/C)	Medium (M/C)	Medium (M/C)	Medium (M/C)	Medium (M/C)	Medium (M/C)
Pipelines	Medium (M/C)	Medium (M/PL)	High (H/C)	Medium (M/C)	Medium (M/C)	High (H/C)

¹ Project-type Cost Risk defined as: L – Low; M – Medium; or H – High.
² Design-completion Cost Risk defined as: C – Conceptual; PL – Planning level; or PD – Pre-design completed.
³ Dam construction associated with the TBWSP option is the 40-foot dam raise. Dam construction associated with the remaining options is the smaller dam raise project to provide water for Clean Water Services. This smaller dam raise would raise the water surface by 12.5 feet if the dam is reconstructed at its current location or 7.5 feet if a new dam is constructed downstream.



6.0 APPLICATION OF OVERALL COST RISK

Based on the evaluation of overall cost risk, a triangular probability distribution will be applied to the capital cost for each individual project within the economic model. The probability ranges associated with each level of overall cost risk are summarized in Table 5. Additional information on integration of the probability distributions into the economic model will be described in TM 9D.

Table 5. Distributions applied to each overall cost risk level		
Level of overall cost risk	Applied cost variability	
	Low	High
Low	-5%	+10%
Medium	-10%	+20%
High	-10%	+30%
Variability applied as a triangular distribution, with the current cost estimate at the peak of the triangle.		