Appendix N
Project Cost and Schedule Risk Analysis Reports

Fargo-Moorhead Metropolitan Area Flood Risk Management

Final Feasibility Report and Environmental Impact Statement

July 2011

US Army Corps of Engineers ®

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US Army Corps
of Engineers®

Fargo-Moorhead Metro Flood Risk Management Project, Feasibility Study, Phase 4

National Economic Development Plan (NED) – Minnesota Option

Project Cost and Schedule Risk Analysis Report

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May 4, 2011

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EXECUTIVE SUMMARY

Under the auspices of the US Army Corps of Engineers (USACE), St. Paul District, this report presents a recommendation for the project cost and schedule contingencies for the Fargo-Moorhead Metro Flood Risk Management Project, Feasibility Study, Phase 4 National Economic Development Plan (NED) – Minnesota Option (Fargo-Moorhead FRM NED). In compliance with Engineer Regulation (ER) 1110-2-1302 CIVIL WORKS COST ENGINEERING, dated September 15, 2008, a formal risk analysis study was conducted for the development of contingency on the project cost. The purpose of this risk analysis study was to establish project contingencies by identifying and measuring the cost and schedule impact of project uncertainties with respect to the estimated project cost.

Specific to the Fargo-Moorhead NED Project, the most likely project cost (at price level) is estimated at approximately $949 Million. Based on the results of the analysis, the Cost Engineering Directory of Expertise for Civil Works (Walla Walla District) recommends a contingency value of $245 Million, or 26%. This contingency includes $181 Million (19%) for cost growth potential due to risk analyzed in the base cost estimate and $65 Million (7%) for cost growth potential due to risk analyzed in the baseline schedule.

Walla Walla Cost Dx performed risk analysis using the *Monte Carlo* technique, producing the aforementioned contingencies and identifying key risk drivers.

The following table ES-1 portrays the development of contingencies (26%). The contingency is based on an 80% confidence level, as per USACE Civil Works guidance.

Table ES-1. Contingency Analysis Table

Most Likely Cost Estimate	**$1,387,078,819**	
Confidence Level	**Value ($$)**	**Contingency (%)**
5%	$1,011,329,628	6.62%
50%	$1,129,751,928	19.11%
80%	**$1,193,932,836**	**25.87%**
95%	$1,252,332,843	32.03%

The following table ES-2 portrays the full costs of the recommended alternative based on the anticipated contracts. The costs are intended to address the congressional request of estimates to implement the project. The contingency is based on an 80% confidence level, as per accepted USACE Civil Works guidance.

Table ES-2. Cost Summary

FARGO-MOORHEAD NED		COST ($1,000)	CNTG ($1,000)	TOTAL ($1,000)
01	LANDS AND DAMAGES	54,782	14,173	68,956
02	RELOCATIONS	84,956	21,980	106,936
06	FISH AND WILDLIFE FACILITIES	11,560	2,991	14,551
08	ROADS, RAILROADS, AND BRIDGES	127,294	32,933	160,228
09	CHANNELS AND CANALS	469,968	121,590	591,558
11	LEVEES AND FLOODWALLS	19,635	5,080	24,715
14	RECREATION FACILITIES	19,206	4,969	24,175
30	PLANNING, ENGINEERING AND DESIGN	109,859	28,423	138,282
31	CONSTRUCTION MANAGEMENT	51,268	13,264	64,532
	TOTAL PROJECT COSTS	**948,530**	**245,403**	**1,193,933**
	Schedule Completion with Contingency	**11 Jan 2018**	**105 months**	**4 Oct 2026**

Notes:
1) Costs include the recommended contingency of 26%.
2) Costs exclude O&M and Life Cycle Cost estimates.

KEY FINDINGS/OBSERVATIONS RECOMMENDATIONS

The key cost risk drivers identified through sensitivity analysis were Risks PPM-8 (Scope Changes), CON-6 (Contract Modifications), and CA-1 (Undefined Acquisition Strategy), which together contribute over 56 percent of the statistical cost variance. PPM-8 captures the risk that changes to scope, as required by stakeholders, may increase the cost of the project. CON-6 captures the risk that there may be cost growth due to post-award modifications to the contracts due to differing site conditions, engineering changes, and/or claims. CA-1 captures the risk that not having a fully developed contract acquisition strategy may result in cost growth.

The key schedule risk drivers identified through sensitivity analysis were Risk PR-1 (Uncertainty with Funding Stream), and PR-5 (Political Factors Change at State, Local, or Federal level), which together contribute over 78 percent of the statistical schedule variance. PR-1 covers the risk that delay in obtaining necessary funding increments my significantly delay the project. PR-5 captures the risk that political factors could change project support and scope, delaying the overall project implementation.

Recommendations, as detailed within the main report, include the implementation of cost and schedule contingencies, further iterative study of risks throughout the project life-cycle, potential mitigation throughout the PED phase, and proactive monitoring and control of risk identified in this study.

MAIN REPORT

1.0 PURPOSE

Under the auspices of the US Army Corps of Engineers (USACE), St. Paul District, this report presents a recommendation for the project cost and schedule contingencies for the Fargo-Moorhead Metro Flood Risk Management Project, Feasibility Study, Phase 4 Locally Preferred Plan (NED) – North Dakota Option (Fargo-Moorhead FRM NED).

2.0 BACKGROUND

The purpose of the Fargo-Moorhead Feasibility Study is to identify measures and develop a regional system to reduce flood risk along the Red River of the North for the entire Fargo-Moorhead metropolitan area. The study PDT collected, evaluated and screened an array of possible flood risk management plans to define the costs, benefits and impacts to the project area. The plans resulted in a diversion channel alternative as the best measures to reduce the flood risk. A diversion through Minnesota around the city of Moorhead offered the plan with the lowest cost having a B/C ratio over one. The local sponsors preferred a diversion alternative through North Dakota around the city of Fargo as a locally preferred plan. The PDT has developed plans and estimates for both the National Economic Development (NED) - Minnesota Plan and the NED – North Dakota plan.

St. Paul District is preparing a Feasibility Report. As a part of this effort, St. Paul District requested that the USACE Cost Engineering Directory of Expertise for Civil Works (Cost Engineering Dx) provide an agency technical review (ATR) of the cost estimate and schedule for LRR. That tasking also included providing a risk analysis study to establish the resulting contingencies.

3.0 REPORT SCOPE

The scope of the risk analysis report is to calculate and present the cost and schedule contingencies at the 80 percent confidence level using the risk analysis processes, as mandated by U.S. Army Corps of Engineers (USACE) Engineer Regulation (ER) 1110-2-1150, Engineering and Design for Civil Works, ER 1110-2-1302, Civil Works Cost Engineering, and Engineer Technical Letter 1110-2-573, Construction Cost Estimating Guide for Civil Works. The report presents the contingency results for cost risks for all project features. The study and presentation does not include consideration for life cycle costs.

3.1 Project Scope

The formal process included extensive involvement of the PDT for risk identification and the development of the risk register. The analysis process evaluated the most likely Micro Computer Aided Cost Estimating System (MCACES) cost estimate, schedule, and funding profiles using Crystal Ball software to conduct a *Monte Carlo* simulation and statistical sensitivity analysis, per the guidance in Engineer Technical Letter (ETL) CONSTRUCTION COST ESTIMATING GUIDE FOR CIVIL WORKS, dated September 30, 2008.

The project technical scope, estimates and schedules were developed and presented by the St. Paul District. Consequently, these documents serve as the basis for the risk analysis.

The scope of this study addresses the identification of problems, needs, opportunities and potential solutions that are viable from an economic, environmental, and engineering viewpoint.

3.2 USACE Risk Analysis Process

The risk analysis process for this study follows the USACE Headquarters requirements as well as the guidance provided by the Cost Engineering Dx. The risk analysis process reflected within this report uses probabilistic cost and schedule risk analysis methods within the framework of the Crystal Ball software. Furthermore, the scope of the report includes the identification and communication of important steps, logic, key assumptions, limitations, and decisions to help ensure that risk analysis results can be appropriately interpreted.

Risk analysis results are also intended to provide project leadership with contingency information for scheduling, budgeting, and project control purposes, as well as to provide tools to support decision making and risk management as the project progresses through planning and implementation. To fully recognize its benefits, cost and schedule risk analysis should be considered as an ongoing process conducted concurrent to, and iteratively with, other important project processes such as scope and execution plan development, resource planning, procurement planning, cost estimating, budgeting and scheduling.

In addition to broadly defined risk analysis standards and recommended practices, this risk analysis was performed to meet the requirements and recommendations of the following documents and sources:

- Cost and Schedule Risk Analysis Process guidance prepared by the USACE Cost Engineering Dx.

- Engineer Regulation (ER) 1110-2-1302 CIVIL WORKS COST ENGINEERING, dated September 15, 2008.

- Engineer Technical Letter (ETL) CONSTRUCTION COST ESTIMATING GUIDE FOR CIVIL WORKS, dated September 30, 2008.

4.0 METHODOLOGY / PROCESS

The Cost Engineering Dx assembled a team, also relying on local St. Paul District staff to further augment labor, expertise and information gathering. The Cost Engineering Dx team consisted of one senior civil cost engineer.

The Cost Engineering Dx cost engineer facilitated a risk identification meeting on site with the St. Paul PDT on January 7, 2010. The initial risk identification meeting also included qualitative analysis to produce a risk register that served as the framework for the risk analysis. The cost and schedule risk models were completed and results reported on January 29, 2010. Several subsequent revisions to the estimates and risk analyses took place between January 29, 2010 and April 17, 2011. The final results were reported on April 17, 2011.

The risk analysis process for this study is intended to determine the probability of various cost outcomes and quantify the required contingency needed in the cost estimate to achieve any desired level of cost confidence.

In simple terms, contingency is an amount added to an estimate to allow for items, conditions or events for which the occurrence or impact is uncertain and that experience suggests will likely result in additional costs being incurred or additional time being required. The amount of contingency included in project control plans depends, at least in part, on the project leadership's willingness to accept risk of project overruns. The less risk that project leadership is willing to accept the more contingency should be applied in the project control plans. The risk of overrun is expressed, in a probabilistic context, using confidence levels.

The Cost Dx guidance for cost and schedule risk analysis generally focuses on the 80-percent level of confidence (P80) for cost contingency calculation. It should be noted that use of P80 as a decision criteria is a risk averse approach (whereas the use of P50 would be a risk neutral approach, and use of levels less than 50 percent would be risk seeking). Thus, a P80 confidence level results in greater contingency as compared to a P50 confidence level. The selection of contingency at a particular confidence level is ultimately the decision and responsibility of the project's District and/or Division management.

The risk analysis process uses *Monte Carlo* techniques to determine probabilities and contingency. The *Monte Carlo* techniques are facilitated computationally by a commercially available risk analysis software package (Crystal Ball) that is an add-in to Microsoft Excel. Cost estimates are packaged into an Excel format and used directly for cost risk analysis purposes. The level of detail recreated in the Excel-format schedule is sufficient for risk analysis purposes that reflect the established risk register, but generally less than that of the native format.

The primary steps, in functional terms, of the risk analysis process are described in the following subsections. Risk analysis results are provided in Section 6.

4.1 Identify and Assess Risk Factors

Identifying the risk factors via the PDT is considered a qualitative process that results in establishing a risk register that serves as the document for the quantitative study using the Crystal Ball risk software. Risk factors are events and conditions that may influence or drive uncertainty in project performance. They may be inherent characteristics or conditions of the project or external influences, events, or conditions such as weather or economic conditions. Risk factors may have either favorable or unfavorable impacts on project cost and schedule.

Formal PDT meetings were held for the purposes of identifying and assessing risk factors. The formal meeting conducted on January 7, 2010 included representatives from plan formulation, project management, geotechnical and hydraulic design, cost engineering, construction, environmental compliance, real estate, and the project sponsors.

The initial formal meetings focused primarily on risk factor identification using brainstorming techniques, but also included some facilitated discussions based on risk factors common to projects of similar scope and geographic location. Subsequent meetings focused primarily on risk factor assessment and quantification.

Additionally, numerous conference calls and informal meetings were conducted throughout the risk analysis process on an as-needed basis to further facilitate risk factor identification, market analysis, and risk assessment.

4.2 Quantify Risk Factor Impacts

The quantitative impacts of risk factors on project plans were analyzed using a combination of professional judgment, empirical data and analytical techniques. Risk factor impacts were quantified using probability distributions (density functions) because risk factors are entered into the Crystal Ball software in the form of probability density functions.

Similar to the identification and assessment process, risk factor quantification involved multiple project team disciplines and functions. However, the quantification process relied more extensively on collaboration between cost engineering and risk analysis team members with lesser inputs from other functions and disciplines. This process used an iterative approach to estimate the following elements of each risk factor:

- Maximum possible value for the risk factor
- Minimum possible value for the risk factor
- Most likely value (the statistical mode), if applicable
- Nature of the probability density function used to approximate risk factor uncertainty
- Mathematical correlations between risk factors
- Affected cost estimate and schedule elements

The resulting product from the PDT discussions is captured within a risk register as presented in section 6 for both cost and schedule risk concerns. Note that the risk register records the PDT's risk concerns, discussions related to those concerns, and potential impacts to the current cost and schedule estimates. The concerns and discussions support the team's decisions related to event likelihood, impact, and the resulting risk levels for each risk event.

4.3 Analyze Cost Estimate and Schedule Contingency

Contingency is analyzed using the Crystal Ball software, an add-in to the Microsoft Excel format of the cost estimate and schedule. *Monte Carlo* simulations are performed by applying the risk factors (quantified as probability density functions) to the appropriate estimated cost and schedule elements identified by the PDT. Contingencies are calculated by applying only the moderate and high level risks identified for each option (i.e., low-level risks are typically not considered, but remain within the risk register to serve historical purposes as well as support follow-on risk studies as the project and risks evolve).

For the cost estimate, the contingency is calculated as the difference between the P80 cost forecast and the baseline cost estimate. Each option-specific contingency is then allocated on a civil works feature level based on the dollar-weighted relative risk of each feature as quantified by *Monte Carlo* simulation. Standard deviation is used as the feature-specific measure of risk for contingency allocation purposes. This approach results in a relatively larger portion of all the project feature cost contingency being allocated to features with relatively higher estimated cost uncertainty.

5.0 PROJECT ASSUMPTIONS

The following data sources and assumptions were used in quantifying the costs associated with the Fargo-Moorhead NED project.

a. The St. Paul District provided MII MCACES (Micro-Computer Aided Cost Estimating Software) files via email. The file title, "MVP FCP_MN_Diversion_Phase_4 with 2009 Equip Rate.mlp" was the basis for the cost and schedule risk analyses.

b. The cost comparisons and risk analyses performed and reflected within this report are based on design scope and estimates that are at the feasibility level.

c. Schedules are analyzed for impact to the project cost in terms of both uncaptured escalation (variance from OMB factors and the local market) and unavoidable fixed contract costs and/or languishing federal administration costs incurred throughout delay.

d. Per the CWCCIS Historical State Adjustment Factors in EM 1110-2-1304, State Adjustment Factors for Minnesota and North Dakota are 1.15 and 0.92, respectively. Taking this into account along with the historical RS Means labor inflation rate and Consumer Price Index (CPI) factor for Minnesota, the average suggests that true inflation is approximately 4.55% higher for the Fargo Metro area than for the national average. This rate was used to calculate the differential between the local market and OMB inflation factors for future construction. For the P80 schedule, this is approximately 1.34% of the contingency.

e. Per the data in the estimate, the Job Office Overhead (JOOH) amount comprises approximately 5% of the Project Cost at Baseline. Thus, the assumed residual fixed cost rate for this project is 5%. For the P80 schedule, this comprises approximately 5.49% of the total contingency due to the accrual of residual fixed costs associated with delay.

f. The Cost Dx guidance generally focuses on the eighty-percent level of confidence (P80) for cost contingency calculation. For this risk analysis, the eighty-percent level of confidence (P80) was used. It should be noted that the use of P80 as a decision criteria is a moderately risk averse approach, generally resulting in higher cost contingencies. However, the P80 level of confidence also assumes a small degree of risk that the recommended contingencies may be inadequate to capture actual project costs.

g. Only high and moderate risk level impacts, as identified in the risk register, were considered for the purposes of calculating cost contingency. Low level risk impacts should be maintained in project management documentation, and reviewed at each project milestone to determine if they should be placed on the risk "watch list".

6.0 RESULTS

The cost and schedule risk analysis results are provided in the following sections. In addition to contingency calculation results, sensitivity analyses are presented to provide decision makers with an understanding of variability and the key contributors to the cause of this variability.

6.1 Risk Register

A risk register is a tool commonly used in project planning and risk analysis. The actual risk register is provided in Appendix A. The complete risk register includes low level risks, as well as additional information regarding the nature and impacts of each risk.

It is important to note that a risk register can be an effective tool for managing identified risks throughout the project life cycle. As such, it is generally recommended that risk registers be updated as the designs, cost estimates, and schedule are further refined, especially on large projects with extended schedules. Recommended uses of the risk register going forward include:

- Documenting risk mitigation strategies being pursued in response to the identified risks and their assessment in terms of probability and impact.
- Providing project sponsors, stakeholders, and leadership/management with a documented framework from which risk status can be reported in the context of project controls.
- Communicating risk management issues.
- Providing a mechanism for eliciting feedback and project control input.
- Identifying risk transfer, elimination, or mitigation actions required for implementation of risk management plans.

6.2 Cost Contingency and Sensitivity Analysis

Table 1 provides the construction cost contingencies calculated for the P80 confidence level and rounded to the nearest thousand. The construction cost contingencies for the P50 and P100 confidence levels are also provided for illustrative purposes only.

Contingency was quantified as approximately $245 Million at the P80 confidence level (26% of the baseline cost estimate). For comparison, the cost contingency at the P50 and P100 confidence levels was quantified as 19% and 49% of the baseline cost estimate, respectively.

Table 1. Project Cost Contingency Summary

Risk Analysis Forecast	Baseline Estimate	Total Contingency[1,2] ($)	Total Contingency (%)
50% Confidence Level			
Project Cost	$1,129,751,928	$181,221,713	19.11%
80% Confidence Level			
Project Cost	$1,193,932,836	$245,402,622	25.87%
100% Confidence Level			
Project Cost	$1,414,017,542	$465,487,327	49.07%

Notes:
1) These figures combine uncertainty in the baseline cost estimates and schedule.
2) A P100 confidence level is an abstract concept for illustration only, as the nature of risk and uncertainty (specifically the presence of "unknown unknowns") makes 100% confidence a theoretical impossibility.

6.2.1 Sensitivity Analysis

Sensitivity analysis generally ranks the relative impact of each risk/opportunity as a percentage of total cost uncertainty. The Crystal Ball software uses a statistical measure (contribution to variance) that approximates the impact of each risk/opportunity contributing to variability of cost outcomes during *Monte Carlo* simulation.

Key cost drivers identified in the sensitivity analysis can be used to support development of a risk management plan that will facilitate control of risk factors and their potential impacts throughout the project lifecycle. Together with the risk register, sensitivity analysis results can also be used to support development of strategies to eliminate, mitigate, accept or transfer key risks.

6.2.2 Sensitivity Analysis Results

The risks/opportunities considered as key or primary cost drivers are ranked in order of importance in contribution to variance bar charts. Opportunities that have a potential to reduce project cost and are shown with a negative sign; risks are shown with a positive sign to reflect the potential to increase project cost. A longer bar in the sensitivity analysis chart represents a greater potential impact to project cost.

Figure 1 presents a sensitivity analysis for cost growth risk from the high level cost risks identified in the risk register. Likewise, Figure 2 presents a sensitivity analysis for schedule growth risk from the high level schedule risks identified in the risk register.

6.3 Schedule and Contingency Risk Analysis

Table 2 provides the schedule duration contingencies calculated for the P80 confidence level. The schedule duration contingencies for the P50 and P100 confidence levels are also provided for illustrative purposes.

Schedule duration contingency was quantified as 96 months based on the P80 level of confidence. These contingencies were used to calculate the projected residual fixed cost impact of project delays that are included in the Table 1 presentation of total cost contingency. The schedule contingencies were calculated by applying the high level schedule risks identified in the risk register for each option to the durations of critical path and near critical path tasks.

The schedule was not resource loaded and contained open-ended tasks and non-zero lags (gaps in the logic between tasks) that limit the overall utility of the schedule risk analysis. These issues should be considered as limitations in the utility of the schedule contingency data presented. Schedule contingency impacts presented in this analysis are based solely on projected residual fixed costs.

Table 2. Schedule Duration Contingency Summary

Risk Analysis Forecast	Baseline Schedule Duration (months)	Contingency[1] (months)
50% Confidence Level		
Project Duration	96	78
80% Confidence Level		
Project Duration	96	105
100% Confidence Level		
Project Duration	96	171

Notes:
1) The schedule was not resource loaded and contained open-ended tasks and non-zero lags (gaps in the logic between tasks) that limit the overall utility of the schedule risk analysis. These issues should be considered as limitations in the utility of the schedule contingency data presented in Table 2.
2) A P100 confidence level is an abstract concept for illustration only, as the nature of risk and uncertainty (specifically the presence of “unknown unknowns”) makes 100% confidence a theoretical impossibility.

Figure 1. Cost Sensitivity Analysis

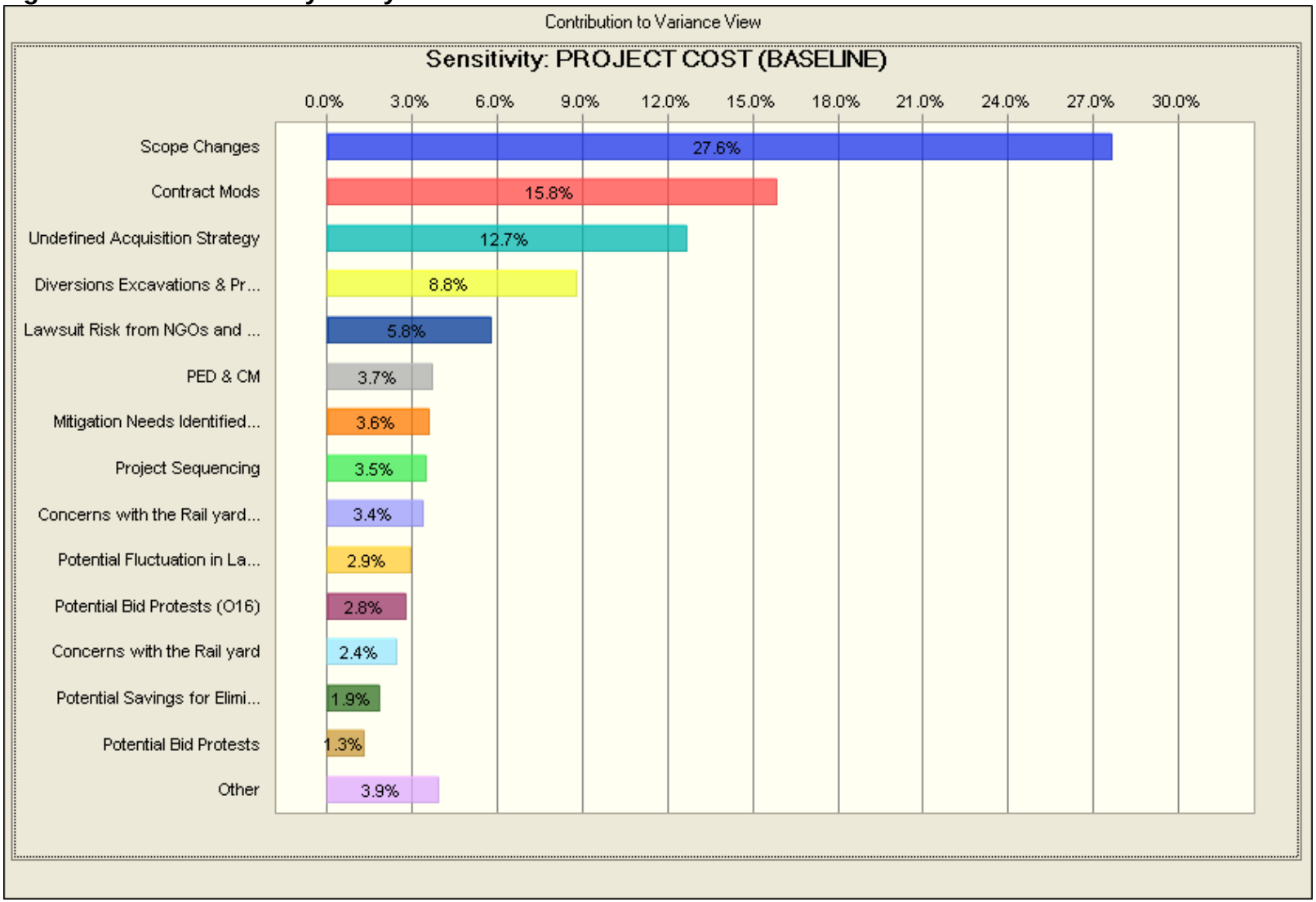
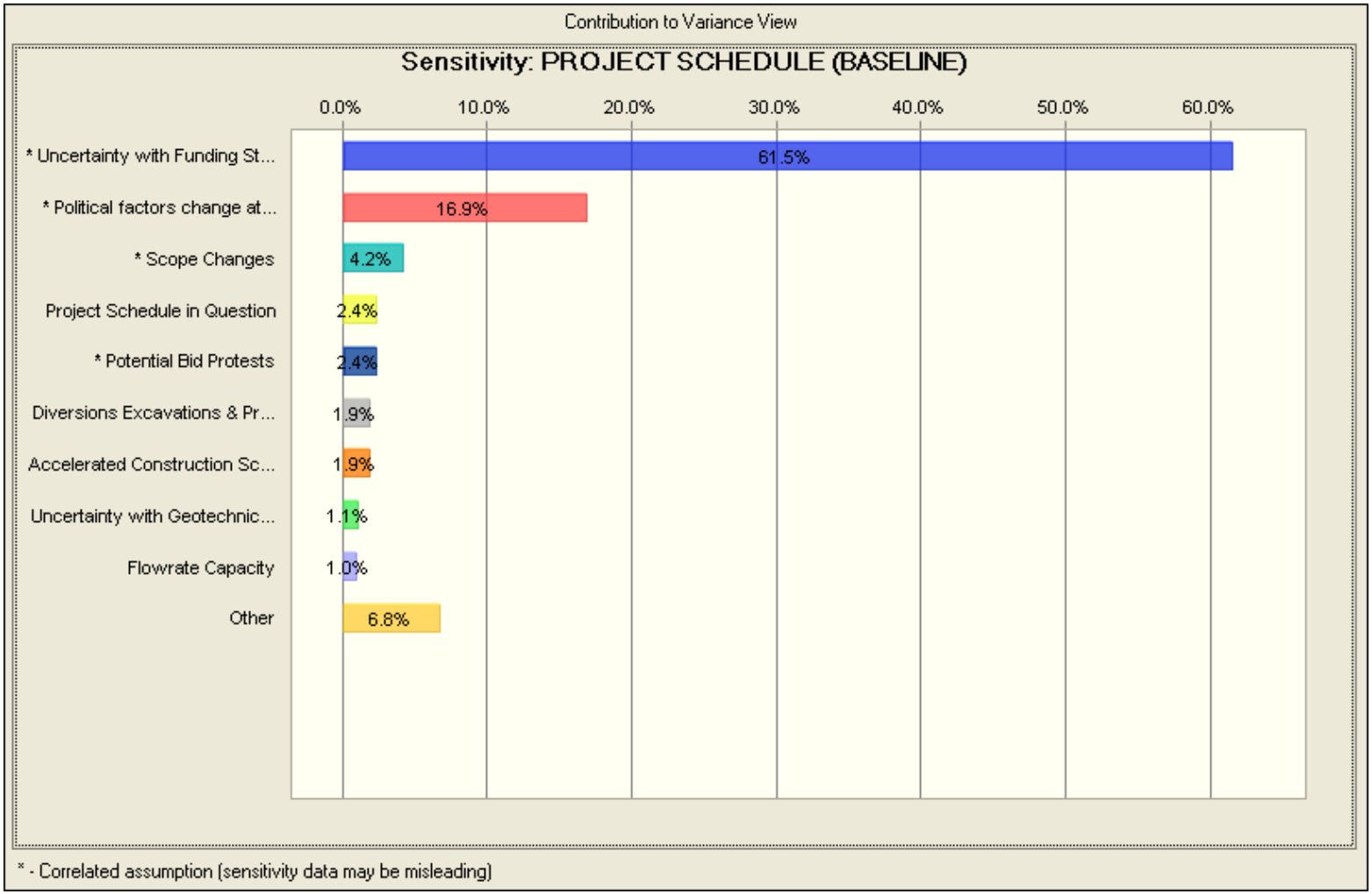


Figure 2. Schedule Sensitivity Analysis



7.0 MAJOR FINDINGS/OBSERVATIONS/RECOMMENDATIONS

This section provides a summary of significant risk analysis results that are identified in the preceding sections of the report. Risk analysis results are intended to provide project leadership with contingency information for scheduling, budgeting, and project control purposes, as well as to provide tools to support decision making and risk management as projects progress through planning and implementation. Because of the potential for use of risk analysis results for such diverse purposes, this section also reiterates and highlights important steps, logic, key assumptions, limitations, and decisions to help ensure that the risk analysis results are appropriately interpreted.

7.1 Major Findings/Observations

Project cost comparison summaries are provided in Table 3 and Figure 3. Additional major findings and observations of the risk analysis are listed below.

1. The key cost risk drivers identified through sensitivity analysis were Risks PPM-8 (Scope Changes), CON-6 (Contract Modifications), and CA-1 (Undefined Acquisition Strategy), which together contribute over 56 percent of the statistical cost variance.

2. The key schedule risk drivers identified through sensitivity analysis were Risk PR-1 (Uncertainty with Funding Stream), and PR-5 (Political Factors Change at State, Local, or Federal level), which together contribute over 78 percent of the statistical schedule variance.

3. Operation and maintenance activities were not included in the cost estimate or schedules. Therefore, a full lifecycle risk analysis could not be performed. Risk analysis results or conclusions could be significantly different if the necessary operation and maintenance activities were included.

Table 3. Project Cost Comparison Summary

Confidence Level	Project Cost ($)	Contingency (%)
P0	**$887,943,310**	**-6.39%**
P5	**$1,011,329,628**	**6.62%**
P10	**$1,035,273,666**	**9.15%**
P15	**$1,051,942,210**	**10.90%**
P20	**$1,065,481,512**	**12.33%**
P25	**$1,078,099,735**	**13.66%**
P30	**$1,089,103,081**	**14.82%**
P35	**$1,099,626,512**	**15.93%**
P40	**$1,109,631,700**	**16.98%**
P45	**$1,119,542,602**	**18.03%**
P50	**$1,129,751,928**	**19.11%**
P55	**$1,139,446,444**	**20.13%**
P60	**$1,149,883,372**	**21.23%**
P65	**$1,159,801,199**	**22.27%**
P70	**$1,170,131,865**	**23.36%**
P75	**$1,181,672,791**	**24.58%**
P80	**$1,193,932,836**	**25.87%**
P85	**$1,207,714,410**	**27.32%**
P90	**$1,226,509,041**	**29.31%**
P95	**$1,252,332,843**	**32.03%**
P100	**$1,414,017,542**	**49.07%**

Figure 3. Project Cost Summary

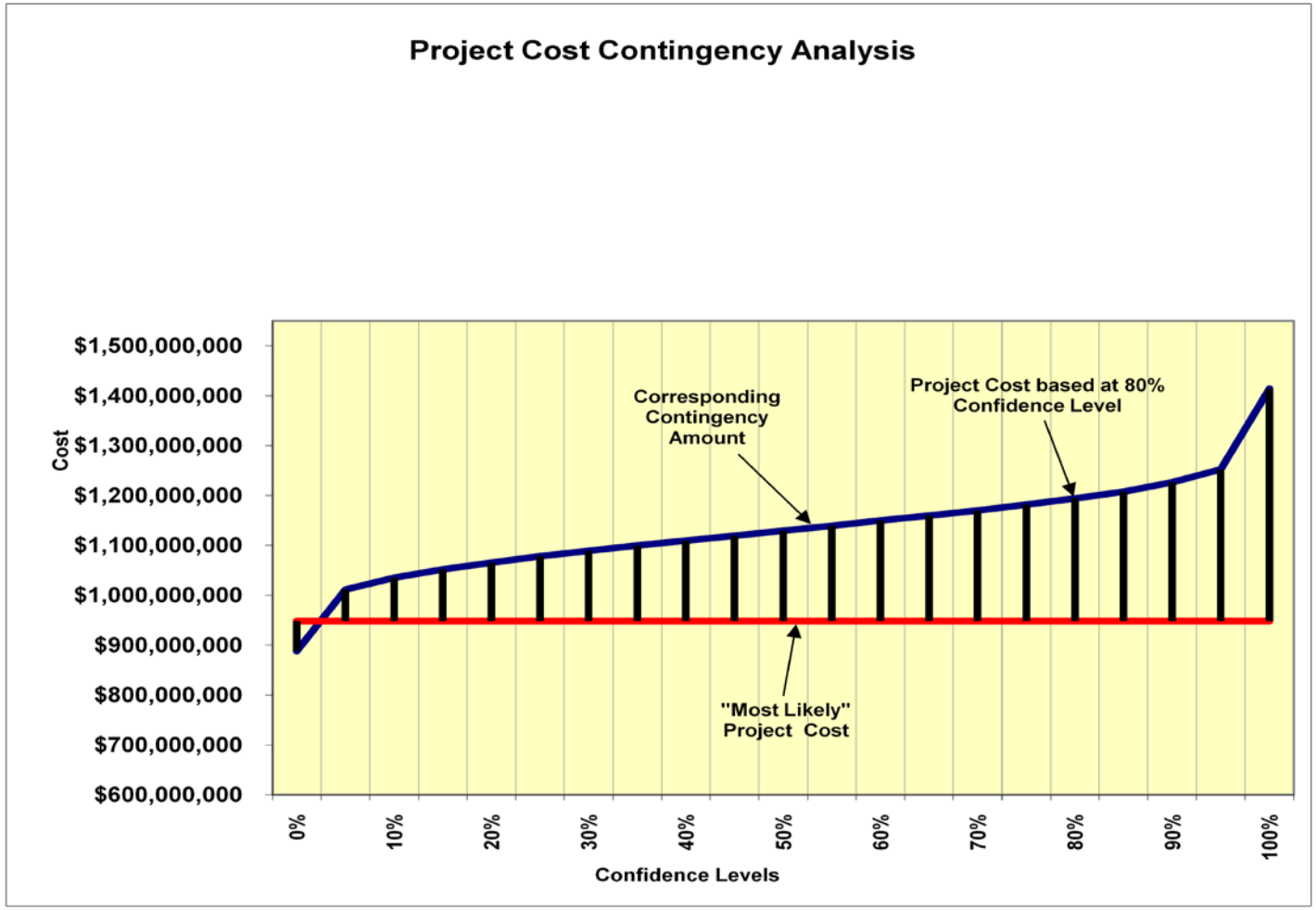
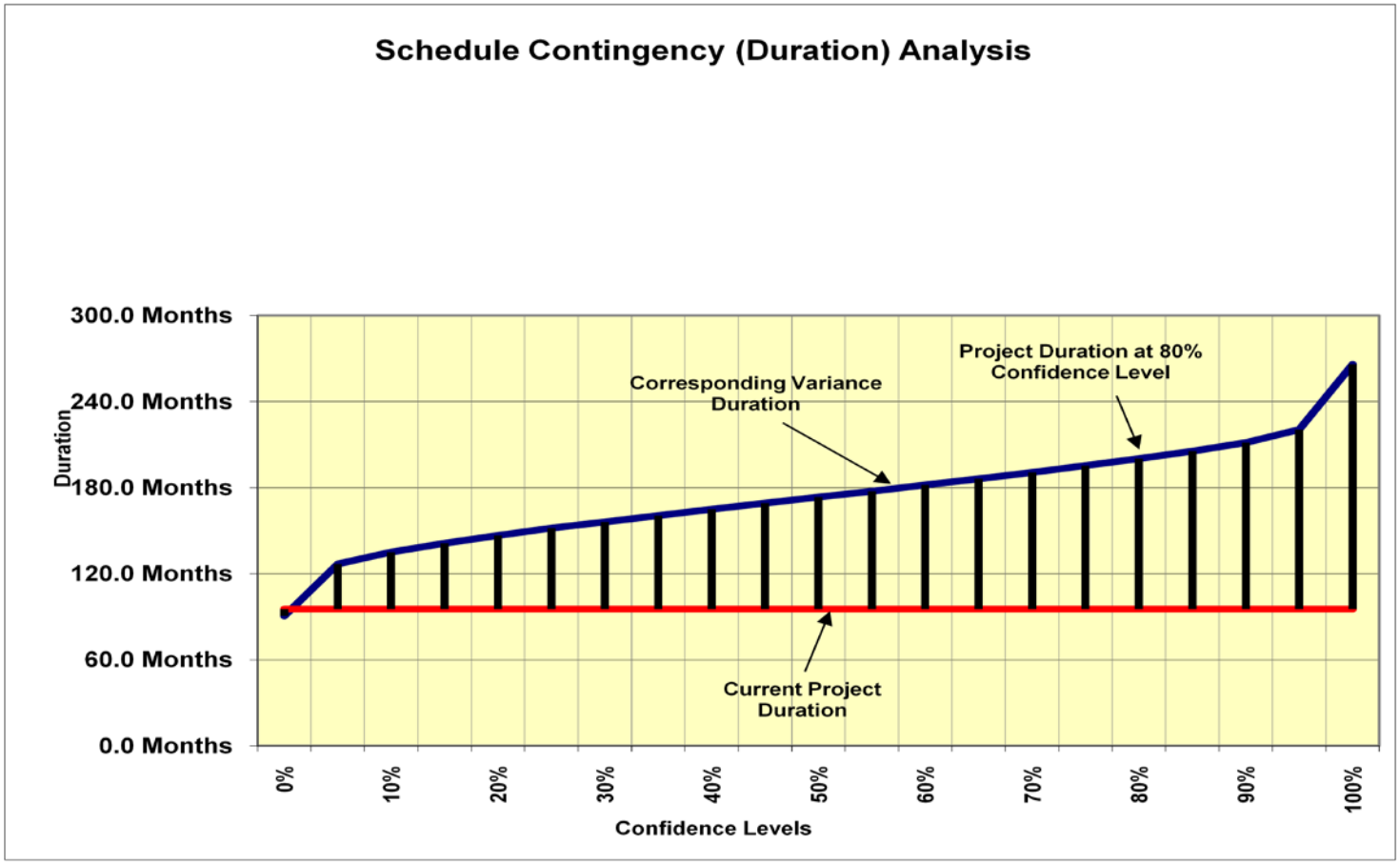


Figure 4. Project Duration Summary



7.2 Recommendations

Risk Management is an all-encompassing, iterative, and life-cycle process of project management. The Project Management Institute's (PMI) *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*, *4th edition*, states that "project risk management includes the processes concerned with conducting risk management planning, identification, analysis, responses, and monitoring and control on a project." Risk identification and analysis are processes within the knowledge area of risk management. Its outputs pertinent to this effort include the risk register, risk quantification (risk analysis model), contingency report, and the sensitivity analysis.

The intended use of these outputs is implementation by the project leadership with respect to risk responses (such as mitigation) and risk monitoring and control. In short, the effectiveness of the project risk management effort requires that the proactive management of risks not conclude with the study completed in this report.

The Cost and Schedule Risk Analysis (CSRA) produced by the PDT identifies issues that require the development of subsequent risk response and mitigation plans. This section provides a list of recommendations for continued management of the risks identified and analyzed in this study. Note that this list is not all inclusive and should not substitute a formal risk management and response plan.

1. Key Cost Risk Drivers: The key cost risk drivers identified through sensitivity analysis were Risks PPM-8 (Scope Changes), CON-6 (Contract Modifications), and CA-1 (Undefined Acquisition Strategy), which together contribute over 56 percent of the statistical cost variance.

a) Scope Changes: Project leadership should attempt to capture and finalize the scope of the project to the maximum extent possible. It is imperative to identify all features of work and probable methodologies, along with the accompanying risks associated with implementation. Iterative quantification (risk analysis) may be necessary to further develop and pinpoint sources of risk to identify needs for risk treatment in the risk response and management plan.

b) Contract Modifications: Project leadership should attempt to capture and finalize the scope of the project to the maximum extent possible. It is imperative to identify all features of work and probable methodologies, along with the accompanying risks associated with implementation. Iterative quantification (risk analysis) may be necessary to further develop and pinpoint sources of risk to identify needs for risk treatment in the risk response and management plan. Additionally, project leadership should determine acquisition strategy and make decisions early to impact the completion of contract documents as to minimize risk of engineering changes and potential claims.

c) Undefined Acquisition Strategy: Project leadership should take proactive measures to obtain decisions regarding acquisition strategy, as well as communication to management regarding the impact of those decisions on cost performance. Project leadership should develop the acquisition strategy to maximize competition and cost control, and so that current working estimates can capture the probable costs.

2. Key Schedule Risk Drivers: The key schedule risk drivers identified through sensitivity analysis were Risk PR-1 (Uncertainty with Funding Stream), and PR-5 (Political Factors Change at State, Local, or Federal level), which together contribute over 78 percent of the statistical schedule variance.

a) Uncertainty with Funding Stream: Project leadership should project leadership proactively develop accurate funding profile projections to capture probable funding requirements. Ultimately, this is an external risk, and its impacts must be communicated to management.

b) Political Factors Change at State, Local, or Federal level: Project leadership should attempt to communicate and coordinate effectively with District management and the other involved project partners and sponsors. Ultimately, this is an external risk, and its impacts must be communicated to management, and funds should be maintained in project reserve for treatment of this risk.

3. Risk Management: Project leadership should use of the outputs created during the risk analysis effort as tools in future risk management processes. The risk register should be updated at each major project milestone. The results of the sensitivity analysis may also be used for response planning strategy and development. These tools should be used in conjunction with regular risk review meetings.

4. Risk Analysis Updates: Project leadership should review risk items identified in the original risk register and add others, as required, throughout the project life-cycle. Risks should be reviewed for status and reevaluation (using qualitative measure, at a minimum) and placed on risk management watch lists if any risk's likelihood or impact significantly increases. Project leadership should also be mindful of the potential for secondary (new risks created specifically by the response to an original risk) and residual risks (risks that remain and have unintended impact following response).

APPENDIX A

MVP - Fargo/Moorhead Feasibility Report (FCP - Minnesota Option) - PDT Risk Register

Overall Project Scope

The Fargo-Moorhead Feasibility Study purpose is to identify measures and develop a regional system to reduce flood risk along the Red River of the North for the entire F-M metroploitan area. The study PDT collected, evaluated and screened an array of possible flood risk management plans to define the costs, benefits and impacts to the project area. The plans resulted in a diversion channel alternative as the best measures to reduce the flood risk. A diversion through Minnesota around the city of Moorhead offered the plan with the lowest cost having a B/C ratio over one. The local sponsors preferred a diversion alternative through North Dakota around the city of Fargo as a locally preferred plan. The PDT has developed plans and estimates for both the MN Plan and the LPP ND plan.

Cost Impacts

For the Fargo/Moorhead Project, any cost impact of $10 Million or higher should be considered at least "Significant."

Anything over $5 Million should be considered at least "Marginal."

Schedule Impacts

For the Fargo/Moorhead Project, any schedule impact of 12 months or greater should be considered at least "Significant."

Anything over 6 months should be considered at least "Marginal."

Risk Level

Likelihood of Occurrence	Negligible	Marginal	Significant	Critical	Crisis
Very Likely	Low	Moderate	High	High	High
Likely	Low	Moderate	High	High	High
Unlikely	Low	Low	Moderate	Moderate	High
Very Unlikely	Low	Low	Low	Low	High

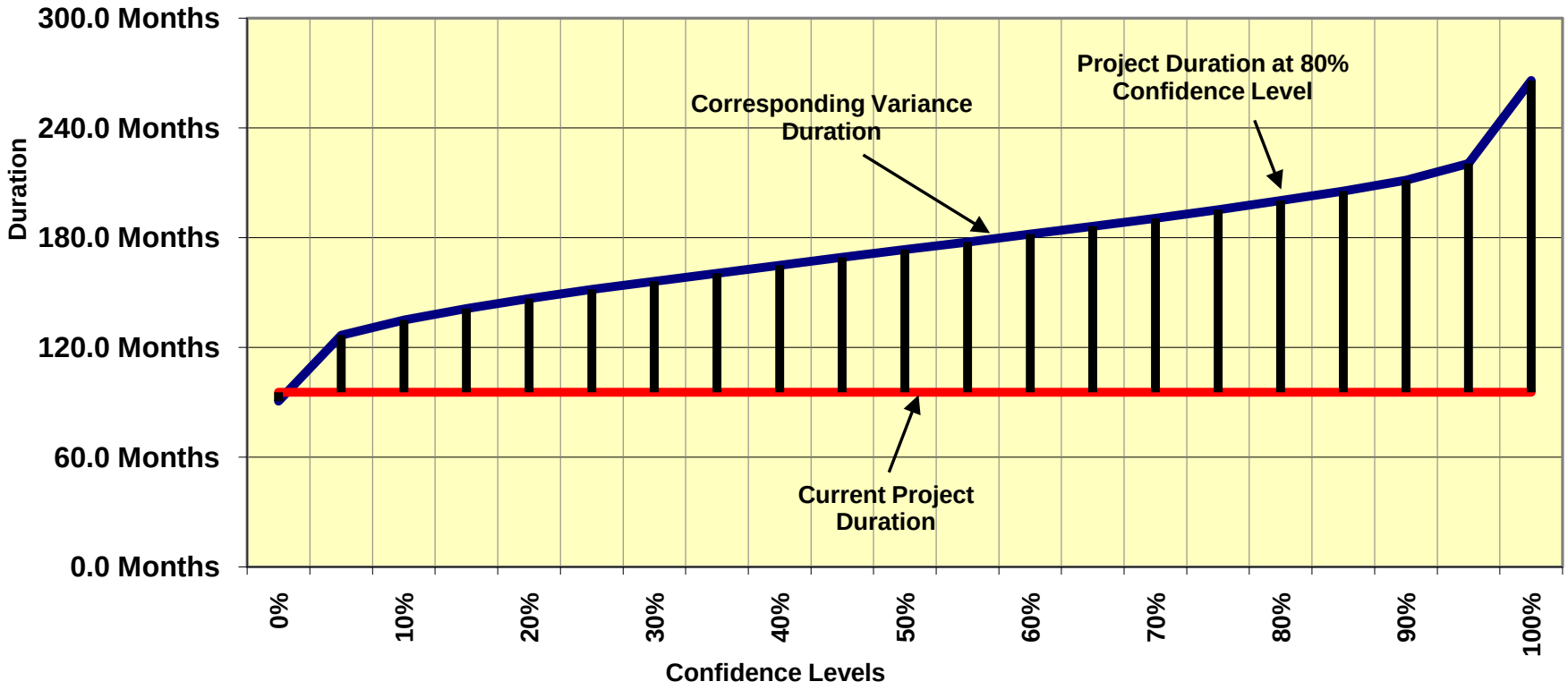
Impact or Consequence of Occurrence

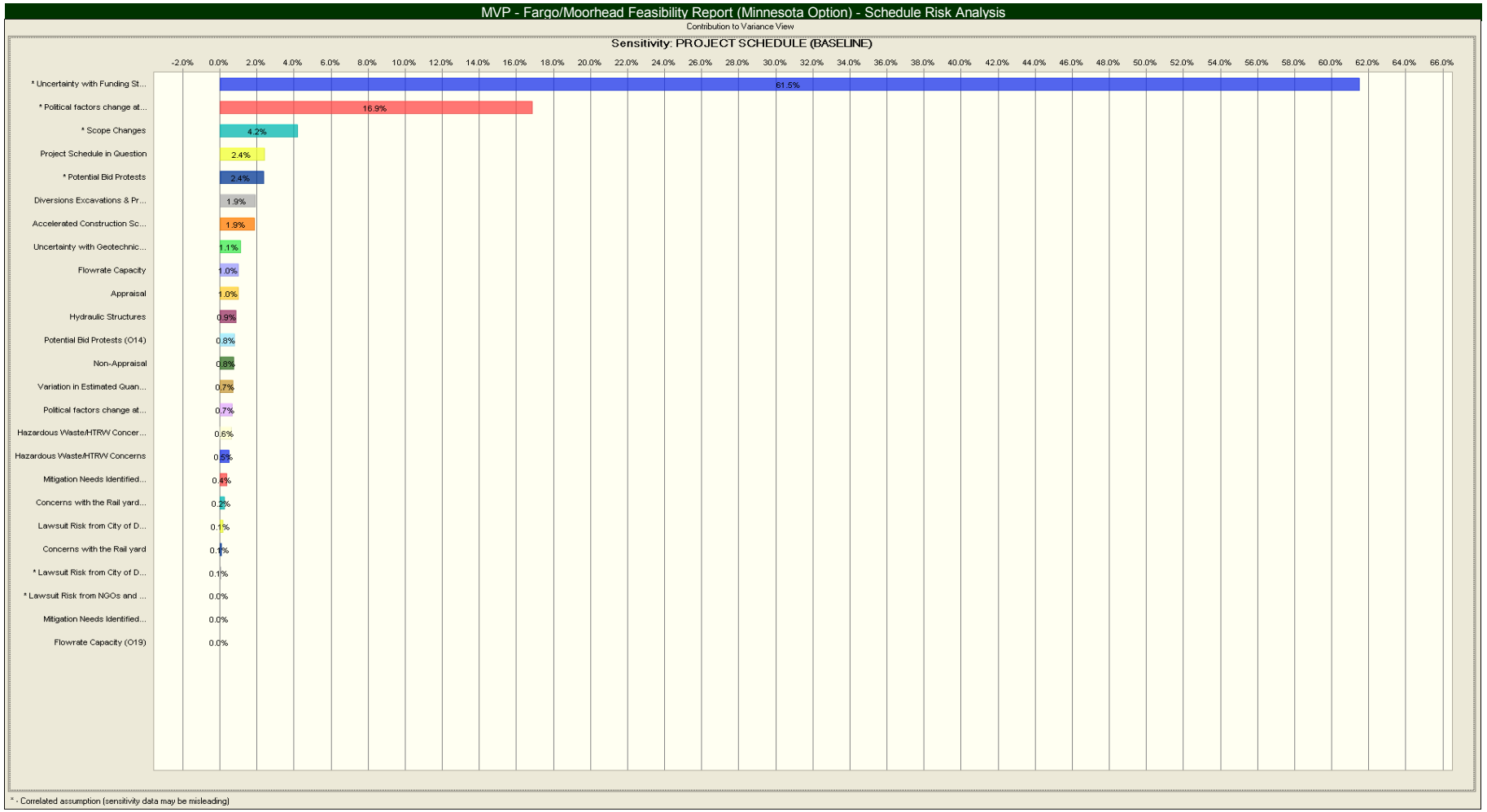
Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions & Conclusions	Project Cost				Project Schedule				Variance Distribution	Correlation to Other(s)	Responsibility/POC	Affected Project Component
				Likelihood*	Impact*	Risk Level*	Rough Order Impact ($)	Likelihood*	Impact*	Risk Level*	Rough Order Impact (mo)				
	Contract Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)														
	PROJECT & PROGRAM MGMT														
PPM-1	Project Schedule Accuracy	Due to the large project size, complexity and sequencing, actual milestones may be different than the current forecast schedule being planned.	This could cause a variance in the project schedule (positive or negative, but most likely negative).	Likely	Significant	High		Likely	Marginal	Moderate		Uniform		Project Manager	Project Cost & Schedule
PPM-2	Accelerated Design Schedule	An accelerated schedule can result in inadequate studies, shortcuts in plans, change in contract acquisition strategy, failure to capture full scope, miss-steps, etc. There is the potential of moving forward with limited information.	An accelerated design schedule could impact the whole project design if there is not enough time to fully plan. This could impact both cost and schedule.	Likely	Significant	High		Likely	Significant	High		Triangular		District Management	Project Cost & Schedule
PM-3	Accelerated Construction Schedule	The need for physical progress on the ground supports construction acceleration as much as practical. Acceleration comes in the form of concurrent construction activities, added overtime costs, perdiem costs, possible contractor conflicts, congested work areas, poorly developed contracts resulting in more modifications and claims.	This could impact cost and schedule	Likely	Marginal	Moderate		Likely	Significant	High		Triangular		District Management	Project Cost & Schedule
PPM-4	Local Agency/Regulator Issues	The acceleration of the planning schedule has forced reviews and collaboration without much time given to local agencies and regulators.	This could impact cost and schedule. There is however about two years before construction starts to resolve issues.	Unlikely	Negligible	Low		Unlikely	Marginal	Low		Yes-No		Project Manager	Project Cost & Schedule
PPM-7	Conflicting Priorities	The District's workload and competing priorities may impede progress on this project related to staff availability and experience, related to design, investigations, contract procurements, construction management.	Since the identity of this concern, the F-M project has been identified as a high priority regional project , and barring a major national disater the F-M project will have all the resources it should need. Unlikely to cause cause any variance in the cost or schedule.	Unlikely	Negligible	Low		Unlikely	Negligible	Low		Uniform		District Management	Project Schedule
PPM-8	Scope Changes	The many competing interests & priorities, coupled with an accelerated schedule could result in scope changes currently uncaptured or unanticipated. These scope changes would require additional coordination, cause further design and investigation and potentially impact the real estate acquisitions.	While minor alterations to the final alignment may occur, there should not be any major changes.	Likely	Marginal	Moderate		Likely	Significant	High		Yes-No		Project Manager	Project Cost & Schedule

Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions & Conclusions	Project Cost				Project Schedule				Variance Distribution	Correlation to Other(s)	Responsibility/POC	Affected Project Component
				Likelihood*	Impact*	Risk Level*	Rough Order Impact ($)	Likelihood*	Impact*	Risk Level*	Rough Order Impact (mo)				
	CONTRACT ACQUISITION RISKS														
CA-1	Undefined Acquisition Strategy	The overall acquisition strategy for both design and construction has not been defined. Acquisition strategy could affect/impact bid competition and bid costs. It can also move risk onto the Government, causing need for greater contingencies. Clarification should be made related to number of contracts, contract types, etc. authority for this procurement.	Acquisition stratagy needs to be defined and could impact the cost and schedule.	Likely	Marginal	Moderate		Unlikely	Marginal	Low		Triangular		TASB	Contract Cost & Project Schedule
CA-2	Preference to Small Business	Most of the larger requirements are so large that they would not be suitable for small business. However, there is potential for some of the restoration, seeding, and mitigation may be suitable for small business. There is a requirement for review by the PARC if the requirements were less than $50 Million.	The project is so large, it is likely that even separable requirements would not be suitable for small business. Could impact cost and schedule.	Unlikely	Marginal	Low		Unlikely	Marginal	Low		Triangular		Contracting	Contract Cost & Project Schedule
CA-3	Numerous Separate Contracts	There is potential to have numerous separate contracts, especially if the continuing contracts authority is not granted. Funding stream issues could also have an impact on the number of contracts. Lack of planning or forsight could result in change of plans, scecs and reactive acquisition.	The best case would be 6 contracts. The worst case would be in excess of 10 contracts. More contracts could increase bidding competition. This could have a significant effect on cost and schedule (either positive or negative).	Very Likely	Significant	High		Unlikely	Marginal	Low		Triangular		Contracting	Contract Cost
CA-4	Potential Bid Protests	The larger size of the project increase contractor interests in bidding, but also increases potntial risk for protets due to hungry economy and interest in obtaining project dollars.	This could impact cost and schedule.	Likely	Marginal	Moderate		Likely	Marginal	Moderate		Yes-No		District Management	Project Cost & Schedule
CA-5	Contracting Staff shortages	Contracting is experiencing a lack of staffing, causing challenges in obtaining resources on a timely basis for all procurements.	Could cause a variance in the schedule, though by the time procuremenrts are needed for construction, staffing issues could be resovled.	Unlikely	Marginal	Low		Unlikely	Marginal	Low		Uniform		District Management	Project Schedule
	TECHNICAL RISKS														
TL-1	Uncertainty with Geotechnical Conditions	There is uncertainty with geotechnical conditions but the Phase 3 estimate uses recent borings from 2010 to help define the the soil parameters for excavation and how that will impact the construction productivity. The material is all clay and silt.	The current working estimate is fairly conservative. However, variation in the ultimate characterization of material could cause significant variance in productivity. Could impact cost and schedule (positive or negative).	Likely	Marginal	Moderate		Likely	Marginal	Moderate		Triangular		Geotechnical/Civil Design	Contract Cost & Project Schedule
TL-2	Survey Data Incomplete	The PDT currently has incomplete or outdated survey data (for bathymetry for the Red River and Tributaries).	If the survey data uncovers data that differs greatly from current conceptual design, it could lead to variance in cost (due to issues such as configuration and details for structures).	Unlikely	Marginal	Low		Unlikely	Negligible	Low		Triangular		Technical Lead	Contract Cost & Project Schedule
TL-3	Hazardous Waste/HTRW Concerns	Due to the project footprint involving BNSF's rail yard, there is the possibility that HTRW or hazardous substances may be encountered.	There is the potential for contaminated and or petroleum based contamination, as well as other deleterious substances. This would only impact schedule, as HTRW cleanup is not part of the project cost.	Very Unlikely	Negligible	Low		Likely	Significant	High		Yes-No		Geotechnical/Civil Design	Contract Cost & Project Schedule
TL-4	Variation in Estimated Quantities	There is potential for variation of estimated quantities in the excavation and earthwork features.	This could impact cost and schedule.	Likely	Significant	High		Likely	Marginal	Moderate		Yes-No		Hydrology/Hydraulic Design	Contract Cost
TL-5	Flowrate Capacity	If during detailed design the hydraulics change, it could affect the amount of flow required for the diversion channel to handle. This would affect channel width, bridge lengths and major hydraulic structure sizes	This could impact Schedule	Unlikely	Marginal	Low		Likely	Marginal	Moderate		Yes-No		Hydrology/Hydraulic Design	Contract Cost & Project Schedule
TL-6	Relocations - Utilities	Quality of design at budget level	Most costs were obtained from affected utilities for the major lines that are impacted.	Likely	Marginal	Moderate		Unlikely	Negligible	Low		Triangular		Cost Engineering	Contract Cost
TL-7	Relocations - Bridges	Bridge costs will change depending on final diversion channel width	Bridge costs from historical DOT costs are fairly reliable.	Likely	Marginal	Moderate		Unlikely	Negligible	Low		Triangular		Cost Engineering	Contract Cost
TL-8	Mitigation	fish, wetlands, forest, adaptive management issues	Resource agencies have not agreed to any particular features yet so there is the potential for additional mitigation beyond what is proposed, though the Corps has laid out a well planned approach to mitigating the issues	Likely	Significant	High		Likely	Negligible	Low		Uniform		Environmental Compliance	Contract Cost
TL-9	Diversions Excavations & Productivity	Excavations could be impacted by diversion alignment changes and/or model results	Impacts should only affect quantities of different soil layers	Likely	Marginal	Moderate		Likely	Marginal	Moderate		Triangular		Technical Lead	Contract Cost
TL-10	Hydraulic Structures	Hydraulic structures will need to be modeled	Model results could change design concepts	Likely	Significant	High		Likely	Marginal	Moderate		Triangular		Technical Lead	Contract Cost & Project Schedule

Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions & Conclusions	Project Cost				Project Schedule				Variance Distribution	Correlation to Other(s)	Responsibility/POC	Affected Project Component
				Likelihood*	Impact*	Risk Level*	Rough Order Impact ($)	Likelihood*	Impact*	Risk Level*	Rough Order Impact (mo)				
TL-11	Levees	Levee heights and lengths could change depending on if upstream staging is incorporated	The FCP MN alternative is not likely to change to incorporate upstream staging	Unlikely	Significant	Moderate		Unlikely	Marginal	Low		Triangular		Technical Lead	Contract Cost
TL-12	Non-Structural Floodproofing	Costs for downstream impacts could change when the effects of have been fully developed	This is dependent on the takings anaylsis which so far has indicated thaqt there is not a takings	Likely	Marginal	Moderate		Unlikely	Marginal	Low		Triangular		Technical Lead	Contract Cost
TL-13	Recreational Facilities	Feasibility is at conceptual design	Fnial designs could look different than Feasibility but overall concepts should be similar	Likely	Marginal	Moderate		Unlikely	Marginal	Low		Triangular		Cost Engineering	Contract Cost
TL-14	Fuel Cost Concerns	Volatility in the price of fuel	Recent spikes in fuel could increase the cost of fule for the project. Conversely, if the world markets calm down, fuel could return to a price lower that currently estimatesd in the project.	Likely	Significant	High		Unlikely	Marginal	Low		Triangular		Cost Engineering	Contract Cost
	LANDS AND DAMAGES RISKS														
LD-1	Concerns with the Rail yard	The alignment currently goes through a BNSF rail yard. Due to the complication of working in an active rail yard, with the requirement of bridge construction/relocation/or reconfiguration could present significant challenges.	The real risk is obtaining agreement from the railroad on the exact configuration of the rail yard crossing. Cost estimate from RR at feasibility level. Could impact cost or schedule.	Likely	Crisis	High		Unlikely	Critical	Moderate		Yes-No		Project Manager	Project Cost & Schedule
LD-2	Mitigation Needs Identified for Downstream Impacts	The effects of the project on areas downstream may require mitigation footprint that has not been finalized. The impacts are not fully captured, and a determination has to be made as to whether a "taking" will be required.	The PDT feels that a "taking" is unlikely. This could significantly impact costs if there is a taking, and it could significantly impact schedule.	Unlikely	Significant	Moderate		Unlikely	Significant	Moderate		Yes-No		Real Estate	Project Cost & Schedule
LD-3	Potential Savings for Eliminating RR Bridge 1	Currently, the BNSF RR haslimited use of this line and indicated that abandonement is possible	This could save the cost of bridge and track raise	Unlikely	Significant	Moderate		Very Unlikely	Negligible	Low		Yes-No		Project Manager	Project Cost & Schedule
LD-4	Appraisal	Appraisals carry certain assumptions based on technical information. If the techncial information has the potential to change, the appraisals could be impacted.	Appraisals are using an average value	Likely	Significant	High		Likely	Marginal	Moderate		Triangular		Real Estate	Project Cost
LD-5	Non-Appraisal	Real Estate office is responsible for establishing contingencies. There could be risks outside their domain that can still impact the costs.	Real Estate office will be using the CSRA contingencies	Likely	Marginal	Moderate		Likely	Marginal	Moderate		Triangular		Real Estate	Project Cost
LD-6	Labor to Process RE	The estimated labor to manage and process the real estate needs may not be properly estimated.	Real Estate office has accounted for RE admin in the estimate	Unlikely	Marginal	Low		Very Unlikely	Negligible	Low		Triangular		Real Estate	Project Cost
	REGULATORY AND ENVIRONMENTAL RISKS														
RE-1	Environmental Mitigation Feature Concerns	The PDT has estimated mitigation features for Phase 4 based on the expected impacts (to include construction and real estate).	This could impact the costs either positively or negatively. This item is more likely to vary on the low side.	Likely	Marginal	Moderate		Very Unlikely	Negligible	Low		Triangular		Environmental Compliance	Project Cost
RE-2	Historical Cultural Resource Issues	There is potential to find cultural resources, particularly on the riverbanks. No cultural resource survey has been completed to date. Mitigiation will probably be necessary.	Could impact cost.	Very Likely	Marginal	Moderate		Unlikely	Marginal	Low		Triangular		Environmental Compliance	Project Cost
RE-3	Fish Passage Issues	There will be fish passage requirement in the project, but the actual configuration has not been finalized/agreed upon by the local agencies.	Could impact cost, however fish passage has been designed into the hydraulic structures so only minor design refinements should be required.	Unlikely	Marginal	Low		Unlikely	Negligible	Low		Triangular		Technical Lead	Project Cost
RE-4	Pressure to Compress Permitting Activities	The local agencies perceive that they are being pressured through the project permitting process.	PDT has programmed this into the schedule, and the agencies are not constricted more than normal review times.	Very Unlikely	Negligible	Low		Unlikely	Negligible	Low		Uniform		Environmental Compliance	Project Cost & Schedule
RE-5	HTRW Issues	There is some potential for discovery of HTRW in the project alignment. Most of the alignment is through farmland.	Could impact cost and schedule. Since most of the project is through farmland there likely should not be any major issues	Unlikely	Marginal	Low		Unlikely	Negligible	Low		Uniform		Environmental Compliance	Project Cost & Schedule

Schedule Contingency (Duration) Analysis



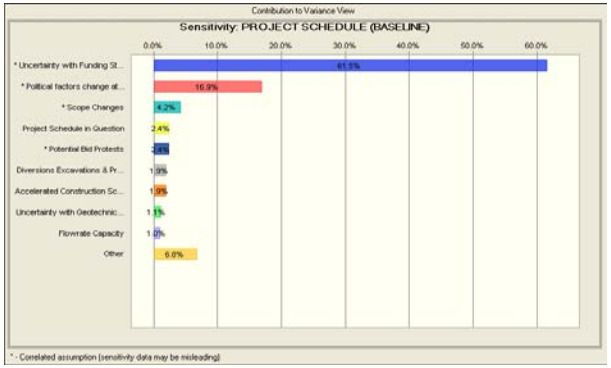

MVP - Fargo/Moorhead Feasibility Report (Minnesota Option) - Schedule Risk Analysis
Contribution to Variance View
Sensitivity: PROJECT SCHEDULE (BASELINE)
-2.0% 0.0% 2.0% 4.0% 6.0% 8.0% 10.0% 12.0% 14.0% 16.0% 18.0% 20.0% 22.0% 24.0% 26.0% 28.0% 30.0% 32.0% 34.0% 36.0% 38.0% 40.0% 42.0% 44.0% 46.0% 48.0% 50.0% 52.0% 54.0% 56.0% 58.0% 60.0% 62.0% 64.0% 66.0%
* Uncertainty with Funding St... 61.5%
* Political factors change at... 16.9%
* Scope Changes 4.2%
Project Schedule in Question 2.4%
* Potential Bid Protests 2.4%
Diversions Excavations & Pr... 1.9%
Accelerated Construction Sc... 1.9%
Uncertainty with Geotechnic... 1.1%
Flowrate Capacity 1.0%
Appraisal 1.0%
Hydraulic Structures 0.9%
Potential Bid Protests (O14) 0.8%
Non-Appraisal 0.8%
Variation in Estimated Quan... 0.7%
Political factors change at... 0.7%
Hazardous Waste/HTRW Concer... 0.6%
Hazardous Waste/HTRW Concerns 0.5%
Mitigation Needs Identified... 0.4%
Concerns with the Rail yard... 0.2%
Lawsuit Risk from City of D... 0.1%
Concerns with the Rail yard 0.1%
* Lawsuit Risk from City of D... 0.1%
* Lawsuit Risk from NGOs and ... 0.0%
Mitigation Needs Identified... 0.0%
Flowrate Capacity (O19) 0.0%
* - Correlated assumption (sensitivity data may be misleading)

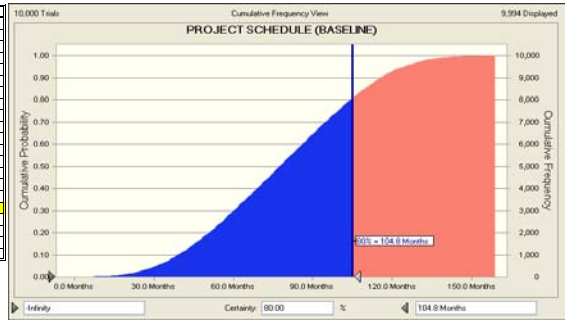
MVP - Fargo/Moorhead Feasibility Report (Minnesota Option) - Schedule Risk Analysis Model

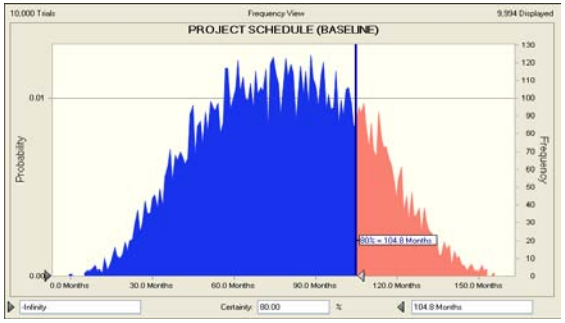
Risk No.	Risk/Opportunity Event	Project Schedule: Likelihood*	Project Schedule: Impact*	Project Schedule: Risk Level*	Variance Distribution	Correlation to Other(s)	Crystal Ball Simulation Expected Values (mos.): Low	Crystal Ball Simulation Expected Values (mos.): Most Likely	Crystal Ball Simulation Expected Values (mos.): High		Crystal Ball Simulation Expected Values (%): Low	Crystal Ball Simulation Expected Values (%): Most Likely	Crystal Ball Simulation Expected Values (%): High	Percentages are calculated as the variance from the assumption value to facilitate iteration of the model should the cost values change throughout the project phases. Uniform distribution percentages reflect variation from the total project cost.
Internal Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)														
PROJECT & PROGRAM MGMT														
PPM-1	Project Schedule in Question	Likely	Marginal	Moderate	Uniform		-6.0 Months	0.0 Months	12.0 Months		-6.29%	0.00%	12.57%	100%
PPM-2	Insufficient Time to Plan	Likely	Significant	High						*Removed from the Analysis, as this is already captured by Risk LD-1*				
PPM-3	Accelerated Construction Schedule	Likely	Significant	High	Triangular		-6.0 Months	0.0 Months	18.0 Months		-6.29%	0.00%	18.86%	100%
PPM-8	Scope Changes	Likely	Significant	High	Uniform		-6.0 Months	0.0 Months	12.0 Months		-6.29%	0.00%	12.57%	100%
CONTRACT ACQUISITION RISKS														
CA-4	Potential Bid Protests	Likely	Marginal	Moderate	Yes-No/Uniform		0.0 Months	0.0 Months	12.0 Months		0.00%	0.00%	12.57%	65%
TECHNICAL RISKS														
TL-1	Uncertainty with Geotechnical Conditions	Likely	Marginal	Moderate	Triangular		-6.0 Months	0.0 Months	12.0 Months		-6.29%	0.00%	12.57%	100%
TL-3	Hazardous Waste/HTRW Concerns	Likely	Significant	High	Yes-No/Uniform		0.0 Months	0.0 Months	12.0 Months		0.00%	0.00%	12.57%	65%
TL-4	Variation in Estimated Quantities	Likely	Marginal	Moderate	Uniform		-6.0 Months	0.0 Months	6.0 Months		-6.29%	0.00%	6.29%	100%
TL-5	Flowrate Capacity	Likely	Marginal	Moderate	Yes-No/Triangular		-12.0 Months	0.0 Months	12.0 Months		-12.57%	0.00%	12.57%	65%
TL-9	Diversions Excavations & Productivity	Likely	Marginal	Moderate	Triangular		-12.0 Months	0.0 Months	12.0 Months		-12.57%	0.00%	12.57%	100%
TL-10	Hydraulic Structures	Likely	Marginal	Moderate	Triangular		0.0 Months	0.0 Months	12.0 Months		0.00%	0.00%	12.57%	100%
LANDS AND DAMAGES RISKS														
LD-1	Concerns with the Rail yard	Unlikely	Critical	Moderate	Yes-No/Triangular		0.0 Months	0.0 Months	12.0 Months		0.00%	0.00%	12.57%	25%
LD-2	Mitigation Needs Identified for Downstream Impacts	Unlikely	Significant	Moderate	Yes-No/Triangular		0.0 Months	0.0 Months	12.0 Months		0.00%	0.00%	12.57%	25%
LD-4	Appraisal	Likely	Marginal	Moderate	Triangular		0.0 Months	0.0 Months	12.0 Months		0.00%	0.00%	12.57%	100%
LD-5	Non-Appraisal	Likely	Marginal	Moderate	Triangular		0.0 Months	0.0 Months	12.0 Months		0.00%	0.00%	12.57%	100%
Programmatic Risks (External Risk Items are those that are generated, caused, or controlled exclusively outside the PDT's sphere of influence.)														
PR-1	Uncertainty with Funding Stream	Very Likely	Significant	High	Uniform	PR-5	0.0 Months	0.0 Months	84.0 Months		0.00%	0.00%	87.99%	100%
PR-4	Lawsuit Risk from City of Dilworth	Unlikely	Significant	Moderate	Yes-No/Uniform		0.0 Months	0.0 Months	6.0 Months		0.00%	0.00%	6.29%	25%
PR-5	Political factors change at state, local, or federal level	Unlikely	Crisis	High	Yes-No/Uniform	PR-1	0.0 Months	0.0 Months	12.0 Months		0.00%	0.00%	12.57%	25%
PR-7	Lawsuit Risk from NGOs and Downstream Interests	Very Likely	Significant	High	Uniform		0.0 Months	0.0 Months	12.0 Months		0.00%	0.00%	12.57%	100%
										Not Part of Study - Placeholder for Project Summation Purposes Only				
								0.0 Months						

95.46351085

	Percentile	Baseline Schedule Duration	Contingency	Baseline w/ Contingency	Contingency %
PROJECT SCHEDULE (BASELINE)	0%	95.5 Months	-4.8 Months	90.7 Months	-5.03%
	5%	95.5 Months	31.3 Months	126.7 Months	32.75%
	10%	95.5 Months	39.6 Months	135.0 Months	41.46%
	15%	95.5 Months	45.7 Months	141.2 Months	47.92%
	20%	95.5 Months	51.3 Months	146.8 Months	53.74%
	25%	95.5 Months	56.4 Months	151.8 Months	59.06%
	30%	95.5 Months	60.7 Months	156.2 Months	63.64%
	35%	95.5 Months	65.1 Months	160.6 Months	68.21%
	40%	95.5 Months	69.5 Months	165.0 Months	72.82%
	45%	95.5 Months	73.8 Months	169.3 Months	77.30%
	50%	95.5 Months	78.1 Months	173.5 Months	81.79%
	55%	95.5 Months	82.1 Months	177.6 Months	86.05%
	60%	95.5 Months	86.6 Months	182.0 Months	90.67%
	65%	95.5 Months	90.8 Months	186.3 Months	95.13%
	70%	95.5 Months	95.2 Months	190.6 Months	99.71%
	75%	95.5 Months	99.9 Months	195.4 Months	104.65%
	80%	95.5 Months	104.8 Months	200.3 Months	109.78%
	85%	95.5 Months	110.0 Months	205.5 Months	115.27%
	90%	95.5 Months	116.0 Months	211.5 Months	121.52%
	95%	95.5 Months	125.0 Months	220.5 Months	130.99%
	100%	95.5 Months	170.5 Months	266.0 Months	178.61%







MVP - Fargo/Moorhead Feasibility Report (Minnesota Option) - Schedule Risk Analysis Model	
Estimated Total Project Cost (Price Level)	$948,530,215
Max. Anticipated Annual Amount	$119,301,192
Enter Current OMB Escalation Rate	1.80%
Enter Current Project Location Escalation Rate	1.88%
Enter Assumed Monthly Recurring Cost Rate	5.00%

	Date	Escalation Delta Amount	Monthly Recurring Cost Amount	Total Schedule Contingency
Enter Current Project Start	29-Jan-10			
Enter Baseline Project Completion	11-Jan-18	$6,037,329.85		$6,037,329.85
Project Completion at 0% Confidence	18-Aug-17	$5,733,853.99	($2,383,968.00)	$3,349,885.99
Project Completion at 5% Confidence	18-Aug-20	$8,014,426.20	$15,531,167.52	$23,545,593.72
Project Completion at 10% Confidence	29-Apr-21	$8,540,617.64	$19,664,687.56	$28,205,305.20
Project Completion at 15% Confidence	2-Nov-21	$8,930,603.07	$22,728,235.34	$31,658,838.42
Project Completion at 20% Confidence	20-Apr-22	$9,282,063.26	$25,489,146.33	$34,771,209.59
Project Completion at 25% Confidence	22-Sep-22	$9,602,767.15	$28,008,449.86	$37,611,217.01
Project Completion at 30% Confidence	1-Feb-23	$9,879,244.66	$30,180,331.13	$40,059,575.79
Project Completion at 35% Confidence	14-Jun-23	$10,155,518.15	$32,350,609.70	$42,506,127.85
Project Completion at 40% Confidence	26-Oct-23	$10,433,770.17	$34,536,430.75	$44,970,200.92
Project Completion at 45% Confidence	4-Mar-24	$10,704,278.88	$36,661,423.82	$47,365,702.70
Project Completion at 50% Confidence	13-Jul-24	$10,975,538.62	$38,792,316.66	$49,767,855.28
Project Completion at 55% Confidence	13-Nov-24	$11,232,499.11	$40,810,881.13	$52,043,380.24
Project Completion at 60% Confidence	27-Mar-25	$11,511,246.53	$43,000,593.74	$54,511,840.26
Project Completion at 65% Confidence	4-Aug-25	$11,780,510.11	$45,115,805.72	$56,896,315.84
Project Completion at 70% Confidence	15-Dec-25	$12,057,020.58	$47,287,945.83	$59,344,966.41
Project Completion at 75% Confidence	8-May-26	$12,355,409.47	$49,631,952.91	$61,987,362.38
Project Completion at 80% Confidence	4-Oct-26	$12,665,315.24	$52,066,431.36	$64,731,746.59
Project Completion at 85% Confidence	12-Mar-27	$12,996,510.50	$54,668,150.32	$67,664,660.82
Project Completion at 90% Confidence	9-Sep-27	$13,373,770.42	$57,631,732.29	$71,005,502.71
Project Completion at 95% Confidence	10-Jun-28	$13,945,340.52	$62,121,726.40	$76,067,066.92
Project Completion at 100% Confidence	24-Mar-32	$16,820,877.15	$84,710,631.15	$101,531,508.30

Entry Required
Do Not Overwrite
Summary Data -- Do Not Overwrite

MVP - Fargo/Moorhead Feasibility Report (Minnesota Option) - Schedule Risk Analysis Model

Risk Refer No.	Risk Event	Low	Most Likely	High
PPM-1	Project Schedule in Question	-6.0 Months	0.0 Months	12.0 Months

Assumes project completion is November 2019. From March 2011 this is = 105 months

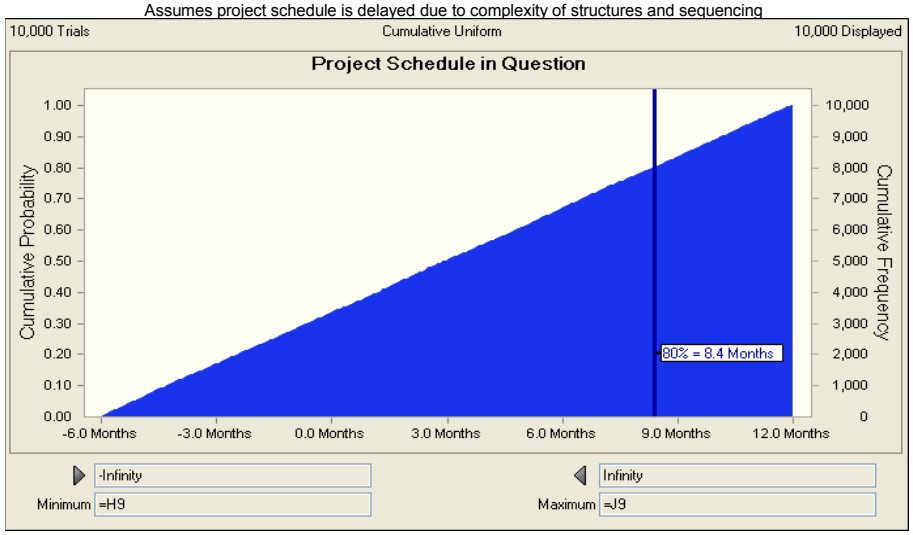
Notes: This item captures the risk that will cause a variance from the baseline schedule for the project.

Likely Likely assumes no change from the baseline schedule.

Low Assumes schedule concerns are conservative and actual project schedule can be exceeded

High

Assumes project schedule is delayed due to complexity of structures and sequencing



Assumption: **Project Schedule in Question**

Percentile	Assumption values
0%	'-6.0 Months
10%	'-4.3 Months
20%	'-2.4 Months
30%	'-0.6 Months
40%	1.2 Months
50%	2.9 Months
60%	4.8 Months
70%	6.5 Months
80%	8.4 Months
90%	10.2 Months
100%	12.0 Months

MVP - Fargo/Moorhead Feasibility Report (Minnesota Option) - Schedule Risk Analysis Model

Risk Refer No.	Risk Event	Low	Most Likely	High	
PPM-2	Accelerated Design Schedule				***Removed from the Analysis, as this is already captured by Risk LD-1***

MVP - Fargo/Moorhead Feasibility Report (Minnesota Option) - Schedule Risk Analysis Model

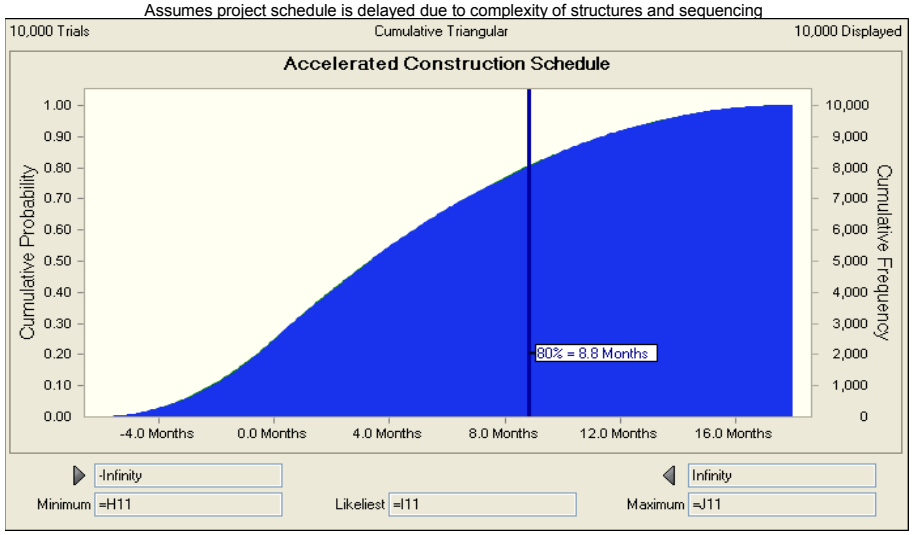
Risk Refer No.	Risk Event	Low	Most Likely	High
PPM-3	Accelerated Construction Schedule	-6.0 Months	0.0 Months	18.0 Months

Notes: This item captures the risk that will cause a variance from the baseline schedule for the project.

Likely Likely assumes no change from the baseline schedule.

Low Assumes schedule concerns are conservative and actual project schedule can be exceeded

High Assumes project schedule is delayed due to complexity of structures and sequencing



Assumption: **Accelerated Construction Schedule**

Percentile	Assumption values
0%	'-5.9 Months
10%	'-2.1 Months
20%	'-0.6 Months
30%	0.6 Months
40%	2.0 Months
50%	3.4 Months
60%	4.9 Months
70%	6.7 Months
80%	8.8 Months
90%	11.4 Months
100%	17.8 Months

MVP - Fargo/Moorhead Feasibility Report (Minnesota Option) - Schedule Risk Analysis Model

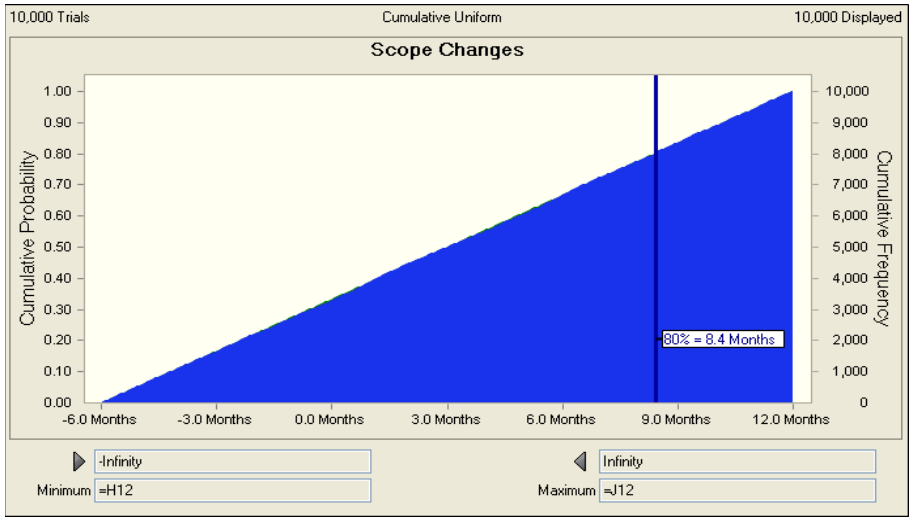
Risk Refer No.	Risk Event	Low	Most Likely	High
PPM-8	Scope Changes	-6.0 Months	0.0 Months	12.0 Months

Notes: This item captures the risk that will cause a variance from the baseline schedule for the project.

Likely Likely assumes no change from the baseline schedule.

Low Assumes scope changes decrease project features and schedule.

High Assumes scope changes increase project features, footprint and schedule.



Assumption: **Scope Changes**

Percentile	Assumption values
0%	'-6.0 Months
10%	'-4.2 Months
20%	'-2.4 Months
30%	'-0.5 Months
40%	1.2 Months
50%	3.0 Months
60%	4.9 Months
70%	6.6 Months
80%	8.4 Months
90%	10.2 Months
100%	12.0 Months

MVP - Fargo/Moorhead Feasibility Report (Minnesota Option) - Schedule Risk Analysis Model

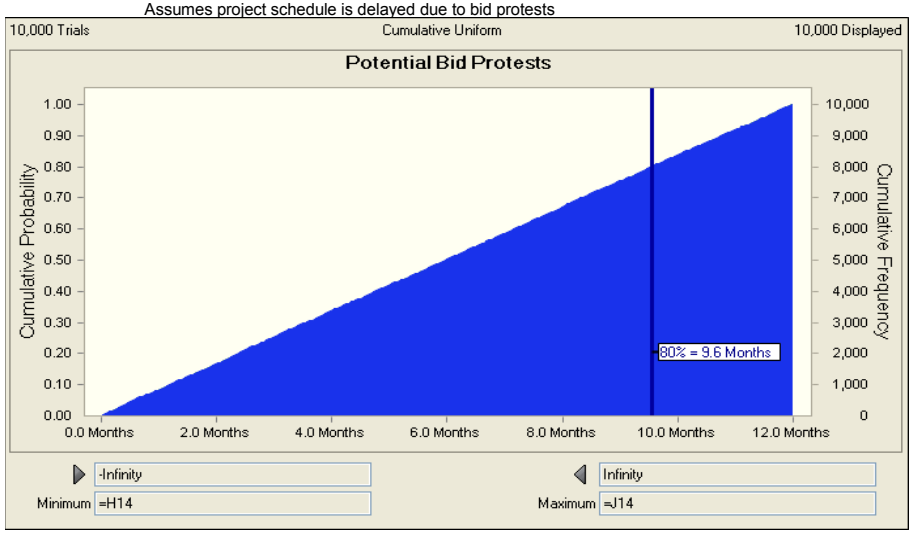
Risk Refer No.	Risk Event	Low	Most Likely	High
CA-4	Potential Bid Protests	0.0 Months	0.0 Months	12.0 Months

Notes: This item captures the risk that will cause a variance from the baseline schedule for the project.

Likely Likely assumes no change from the baseline schedule.

Low Assumes that there are not any bid protest so no changes from baseline schedule

High Assumes project schedule is delayed due to bid protests



Assumption: **Potential Bid Protests**

Percentile	Assumption values
0%	0.0 Months
10%	1.2 Months
20%	2.4 Months
30%	3.5 Months
40%	4.8 Months
50%	6.0 Months
60%	7.2 Months
70%	8.3 Months
80%	9.6 Months
90%	10.8 Months
100%	12.0 Months

MVP - Fargo/Moorhead Feasibility Report (Minnesota Option) - Schedule Risk Analysis Model

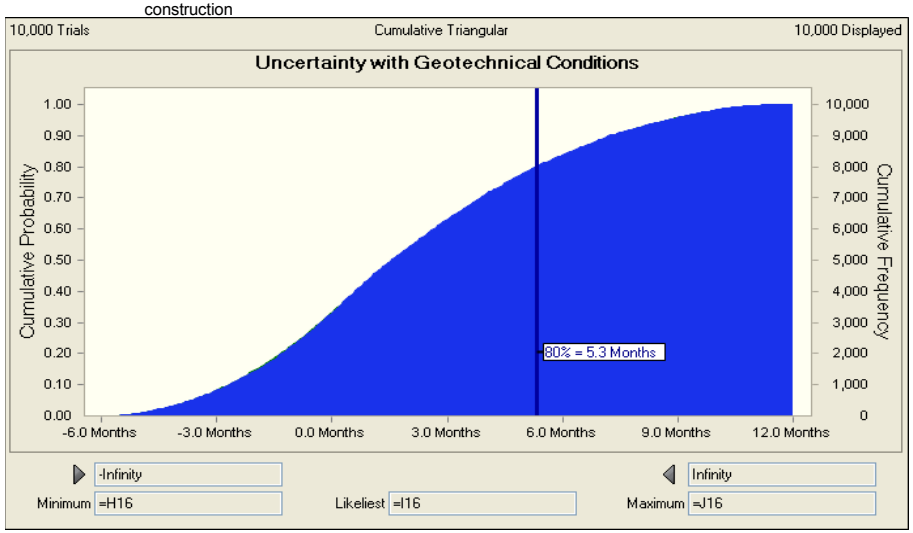
Risk Refer No.	Risk Event	Low	Most Likely	High
TL-1	Uncertainty with Geotechnical Conditions	-6.0 Months	0.0 Months	12.0 Months

Notes: This item captures the risk that will cause a variance from the baseline schedule for the project.

Likely Likely assumes no change from the baseline schedule.

Low Assumes that best case geotechnical conditions allow construction to advance by 6 months

High Assumes that uncertainty with geotechnical condtions causes 12 month delay in construction



Assumption: **Uncertainty with Geotechnical Conditions**

Percentile	Assumption values
0%	'-5.8 Months
10%	'-2.6 Months
20%	'-1.3 Months
30%	'-0.3 Months
40%	0.6 Months
50%	1.6 Months
60%	2.7 Months
70%	3.9 Months
80%	5.3 Months
90%	7.3 Months
100%	11.8 Months

MVP - Fargo/Moorhead Feasibility Report (Minnesota Option) - Schedule Risk Analysis Model

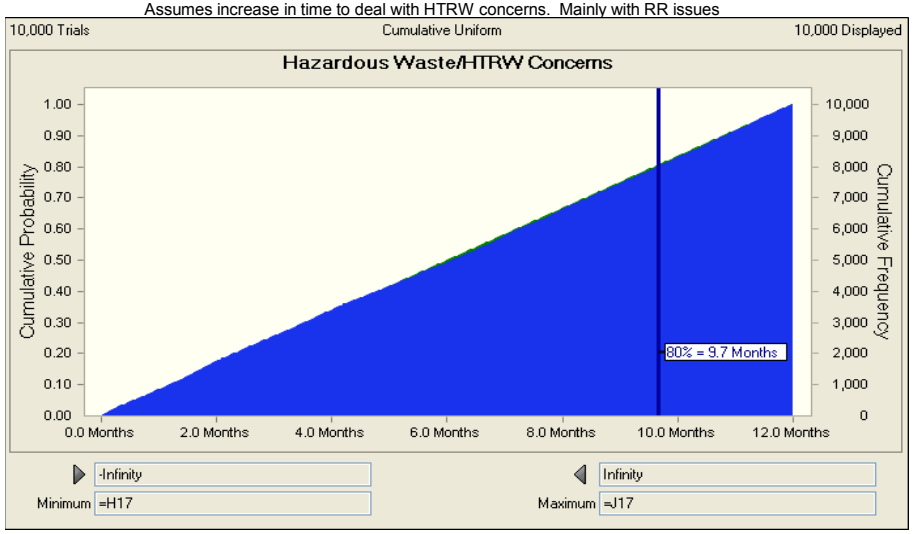
Risk Refer No.	Risk Event	Low	Most Likely	High
TL-3	Hazardous Waste/HTRW Concerns	0.0 Months	0.0 Months	12.0 Months

Notes: This item captures the risk that will cause a variance from the baseline schedule for the project.

Likely Likely assumes no change from the baseline schedule.

Low Assumes no change from the baseline since baseline assumes not finding any HTRW concerns

High Assumes increase in time to deal with HTRW concerns. Mainly with RR issues



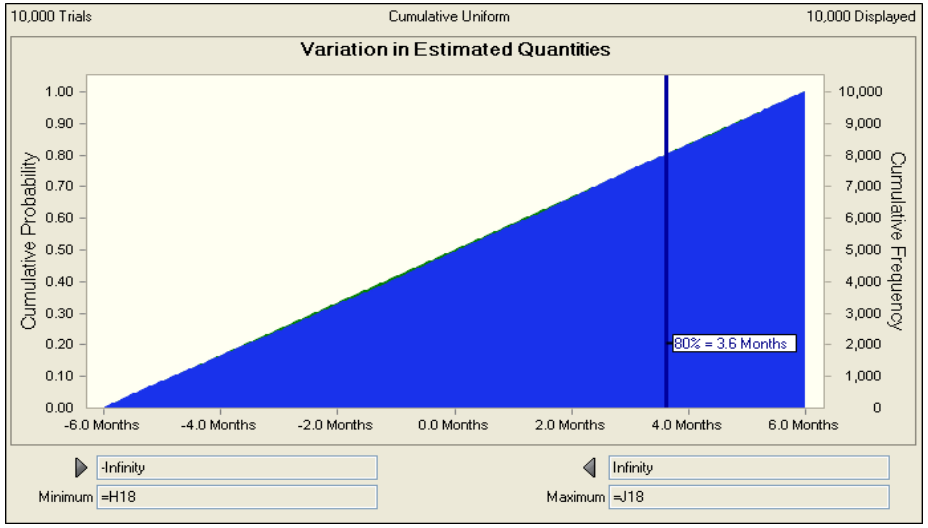
Assumption: **Hazardous Waste/HTRW Concerns**

Percentile	Assumption values
0%	0.0 Months
10%	1.2 Months
20%	2.3 Months
30%	3.5 Months
40%	4.8 Months
50%	6.1 Months
60%	7.3 Months
70%	8.5 Months
80%	9.7 Months
90%	10.8 Months
100%	12.0 Months

MVP - Fargo/Moorhead Feasibility Report (Minnesota Option) - Schedule Risk Analysis Model

Risk Refer No.	Risk Event	Low	Most Likely	High
TL-4	Variation in Estimated Quantities	-6.0 Months	0.0 Months	6.0 Months

Notes: This item captures the risk that will cause a variance from the baseline schedule for the project.
Likely Likely assumes no change from the baseline schedule.
Low Assumes quantities are less than baseline
High Assume quantities are greater than baseline



Assumption: **Variation in Estimated Quantities**

Percentile	Assumption values
0%	'-6.0 Months
10%	'-4.8 Months
20%	'-3.5 Months
30%	'-2.3 Months
40%	'-1.1 Months
50%	0.1 Months
60%	1.3 Months
70%	2.4 Months
80%	3.6 Months
90%	4.8 Months
100%	6.0 Months

MVP - Fargo/Moorhead Feasibility Report (Minnesota Option) - Schedule Risk Analysis Model

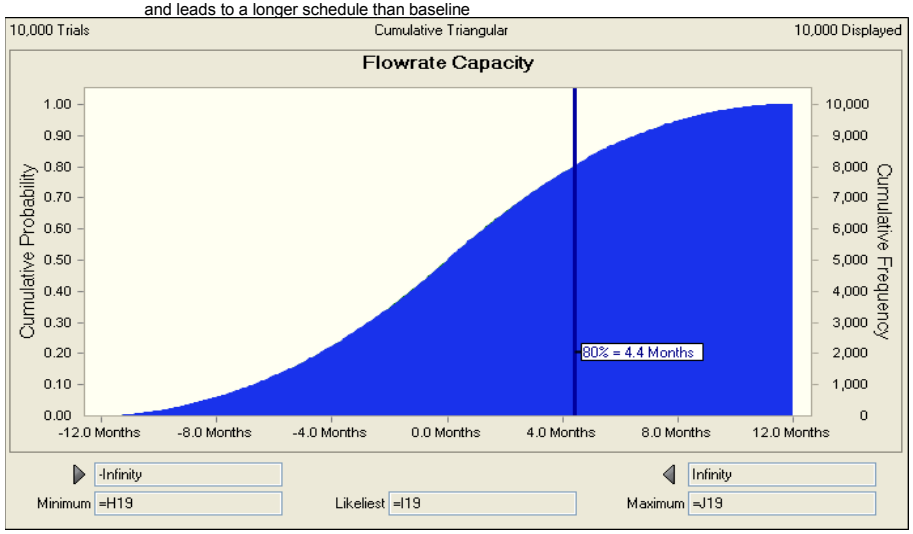
Risk Refer No.	Risk Event	Low	Most Likely	High
TL-5	Flowrate Capacity	-12.0 Months	0.0 Months	12.0 Months

Notes: This item captures the risk that will cause a variance from the baseline schedule for the project.

Likely Likely assumes no change from the baseline schedule.

Low Assumes required flowrates are less which decreases project footprint and quantities and leads to a shorter schedule than baseline

High Assumes required flowrates are greater which increases project footprint and quantities and leads to a longer schedule than baseline



Assumption: **Flowrate Capacity**

Percentile	Assumption values
0%	'-11.9 Months
10%	'-6.7 Months
20%	'-4.4 Months
30%	'-2.7 Months
40%	'-1.2 Months
50%	0.0 Months
60%	1.3 Months
70%	2.7 Months
80%	4.4 Months
90%	6.6 Months
100%	11.9 Months

MVP - Fargo/Moorhead Feasibility Report (Minnesota Option) - Schedule Risk Analysis Model

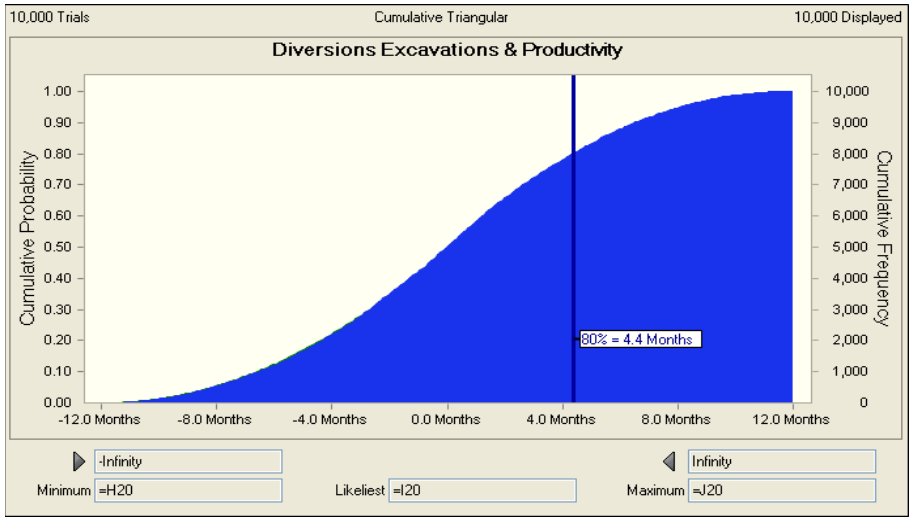
Risk Refer No.	Risk Event	Low	Most Likely	High
TL-9	Diversions Excavations & Productivity	-12.0 Months	0.0 Months	12.0 Months

Notes: This item captures the risk that will cause a variance from the baseline schedule for the project.

Likely Likely assumes no change from the baseline schedule.

Low Assumes diverson alignment changes decrease footprint and quantities making for a shorter schedule than the baseline

High Assumes diverson alignment changes increase footprint and quantities making for a longer schedule than the baseline



Assumption: **Diversions Excavations & Productivity**

Percentile	Assumption values
0%	'-11.8 Months
10%	'-6.5 Months
20%	'-4.3 Months
30%	'-2.7 Months
40%	'-1.3 Months
50%	0.0 Months
60%	1.2 Months
70%	2.7 Months
80%	4.4 Months
90%	6.6 Months
100%	11.7 Months

MVP - Fargo/Moorhead Feasibility Report (Minnesota Option) - Schedule Risk Analysis Model

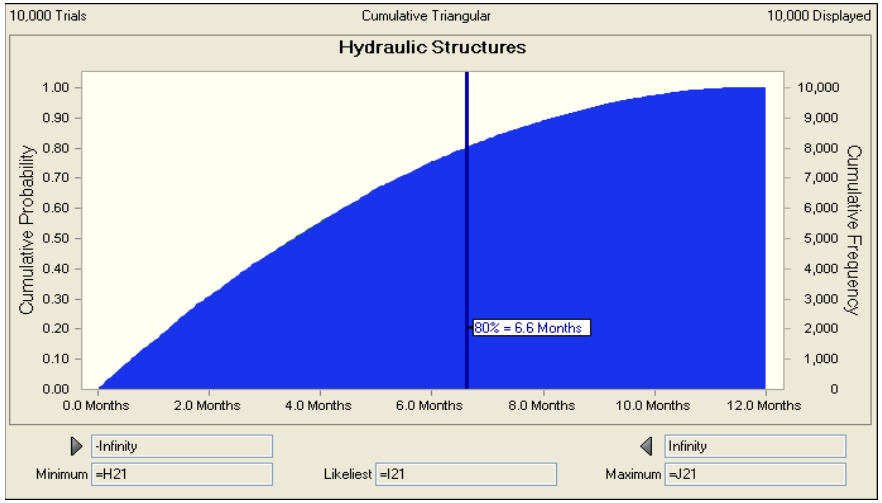
Risk Refer No.	Risk Event	Low	Most Likely	High
TL-10	Hydraulic Structures	0.0 Months	0.0 Months	12.0 Months

Notes: This item captures the risk that will cause a variance from the baseline schedule for the project.

Likely Likely assumes no change from the baseline schedule.

Low Assumes model studies of hydraulic structures shows that cuurent design is adequate or that structures can be smaller. However smaller structures would probably not reduce the project schedule from the baseline since channel excavation would most likely be controlling

High Assumes model studies of hydraulic structures shows that cuurent design is not adequate and that structures should be larger. Additional design and construction time may result



Assumption: **Hydraulic Structures**

Percentile	Assumption values
0%	0.0 Months
10%	0.6 Months
20%	1.3 Months
30%	2.0 Months
40%	2.7 Months
50%	3.6 Months
60%	4.4 Months
70%	5.4 Months
80%	6.6 Months
90%	8.2 Months
100%	11.9 Months

MVP - Fargo/Moorhead Feasibility Report (Minnesota Option) - Schedule Risk Analysis Model

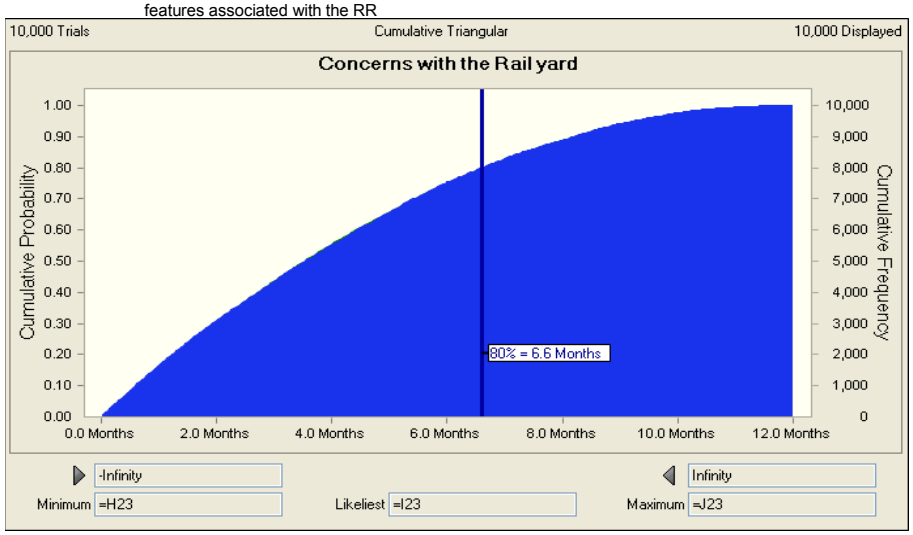
Risk Refer No.	Risk Event	Low	Most Likely	High
LD-1	Concerns with the Rail yard	0.0 Months	0.0 Months	12.0 Months

Notes: This item captures the risk that will cause a variance from the baseline schedule for the project.

Likely Likely assumes no change from the baseline schedule.

Low Assumes agreements can be reached successfully and quickly with RR but that this most likely would not decrease the schedule from the baseline

High Assumes agreements are not reached quickly with RR and delays the construction of features associated with the RR



Assumption: **Concerns with the Rail yard**

Percentile	Assumption values
0%	0.0 Months
10%	0.6 Months
20%	1.2 Months
30%	1.9 Months
40%	2.7 Months
50%	3.5 Months
60%	4.4 Months
70%	5.4 Months
80%	6.6 Months
90%	8.2 Months
100%	12.0 Months

MVP - Fargo/Moorhead Feasibility Report (Minnesota Option) - Schedule Risk Analysis Model

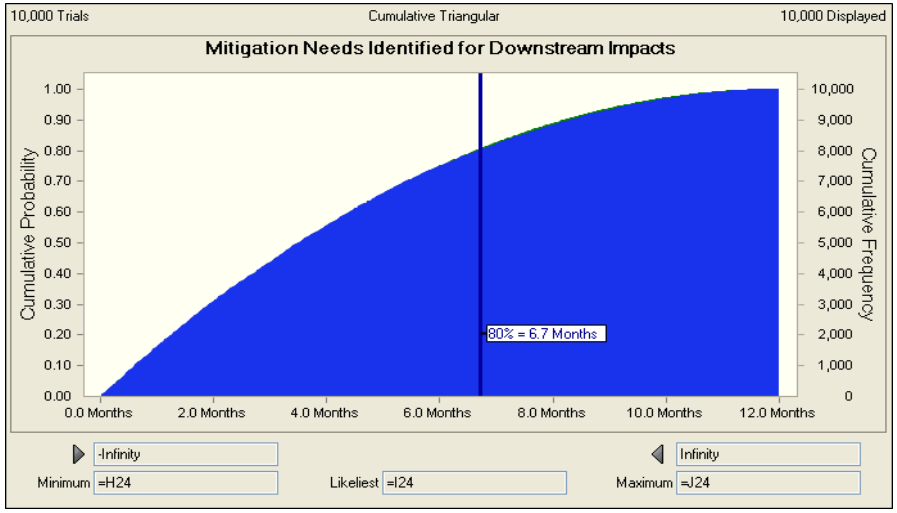
Risk Refer No.	Risk Event	Low	Most Likely	High
LD-2	Mitigation Needs Identified for Downstream Impacts	0.0 Months	0.0 Months	12.0 Months

Notes: This item captures the risk that will cause a variance from the baseline schedule for the project.

Likely Likely assumes no change from the baseline schedule.

Low Assumes no change from baseline since baseline does not currently have any downstream mitigation for impacts for the project

High Assumes delay in project to mitigate impacts to areas downstream.



Assumption: **Mitigation Needs Identified for Downstream Impacts**

Percentile	Assumption values
0%	0.0 Months
10%	0.6 Months
20%	1.3 Months
30%	1.9 Months
40%	2.7 Months
50%	3.5 Months
60%	4.4 Months
70%	5.4 Months
80%	6.7 Months
90%	8.3 Months
100%	11.9 Months

MVP - Fargo/Moorhead Feasibility Report (Minnesota Option) - Schedule Risk Analysis Model

Risk Refer No.	Risk Event	Low	Most Likely	High
LD-4	Appraisal	0.0 Months	0.0 Months	12.0 Months

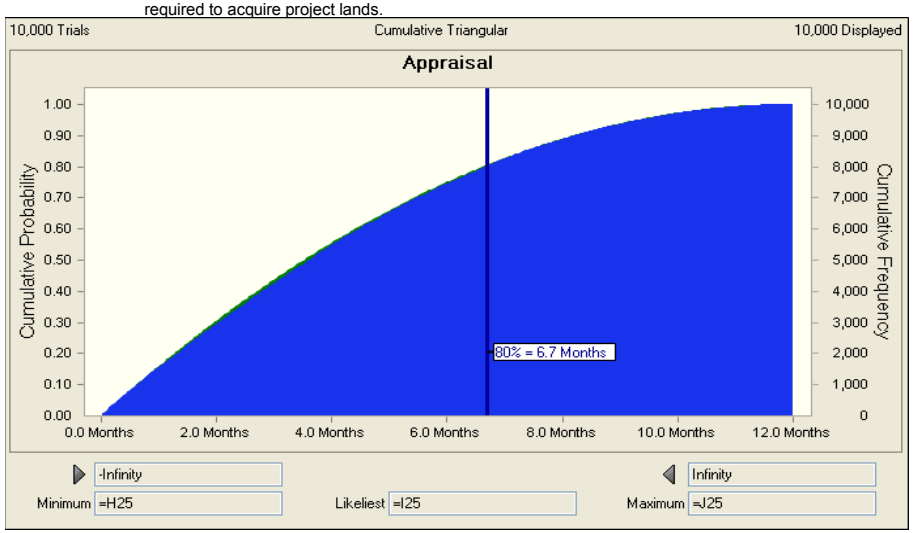
Notes: This item captures the risk that will cause a variance from the baseline schedule for the project.

Likely Likely assumes no change from the baseline schedule.

Low Assumes no change from baseline since project schedule would be controled by construction schedule

High

Assumes delay in project schedule from appraisals that are to low and condemnation is required to acquire project lands.



Assumption: **Appraisal**

Percentile	Assumption values
0%	0.0 Months
10%	0.6 Months
20%	1.3 Months
30%	2.1 Months
40%	2.8 Months
50%	3.6 Months
60%	4.5 Months
70%	5.5 Months
80%	6.7 Months
90%	8.2 Months
100%	11.9 Months

MVP - Fargo/Moorhead Feasibility Report (Minnesota Option) - Schedule Risk Analysis Model

Risk Refer No.	Risk Event	Low	Most Likely	High
LD-5	Non-Appraisal	0.0 Months	0.0 Months	12.0 Months

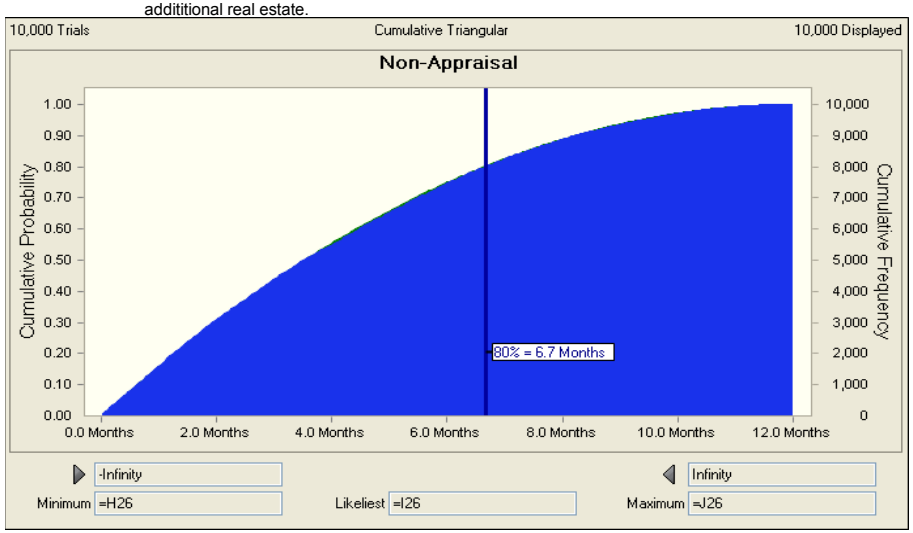
Notes: This item captures the risk that will cause a variance from the baseline schedule for the project.

Likely Likely assumes no change from the baseline schedule.

Low Assumes no change from baseline since project schedule would be controled by construction schedule

High

Assumes delay in project schedule from project footprint increasing and requiring addititional real estate.



Assumption: **Non-Appraisal**

Percentile	Assumption values
0%	0.0 Months
10%	0.6 Months
20%	1.2 Months
30%	1.9 Months
40%	2.7 Months
50%	3.5 Months
60%	4.5 Months
70%	5.5 Months
80%	6.7 Months
90%	8.2 Months
100%	11.9 Months

MVP - Fargo/Moorhead Feasibility Report (Minnesota Option) - Schedule Risk Analysis Model

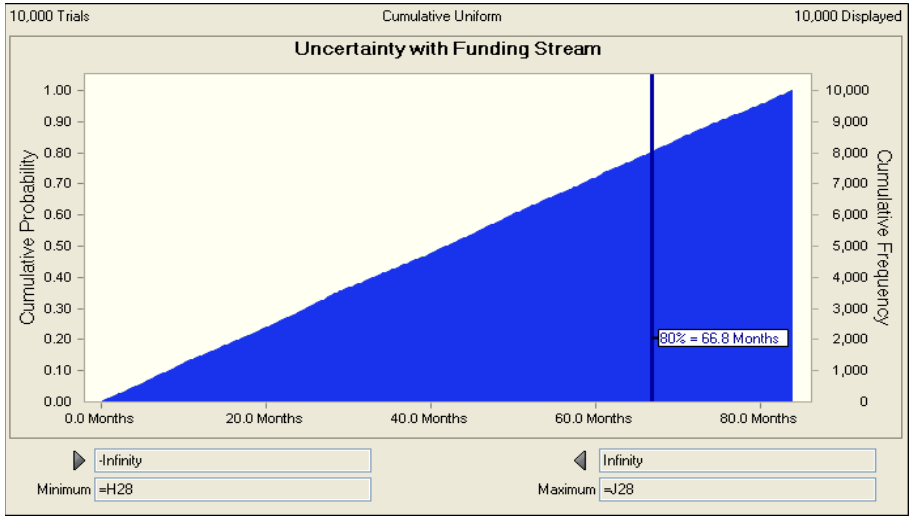
Risk Refer No.	Risk Event	Low	Most Likely	High
PR-1	Uncertainty with Funding Stream	0.0 Months	0.0 Months	84.0 Months

Notes: This item captures the risk that will cause a variance from the baseline schedule for the project.

Likely Likely assumes no change from the baseline schedule.

Low Assumes that funding will not be higher than the proposed project schedule

High Assumes that funding will be at the alternate funding of schedule of $80M/year which may take an additional 7 years.



Assumption: **Uncertainty with Funding Stream**

Percentile	Assumption values
0%	0.0 Months
10%	8.2 Months
20%	16.8 Months
30%	25.0 Months
40%	33.1 Months
50%	42.0 Months
60%	50.0 Months
70%	58.4 Months
80%	66.8 Months
90%	75.2 Months
100%	84.0 Months

MVP - Fargo/Moorhead Feasibility Report (Minnesota Option) - Schedule Risk Analysis Model

Risk Refer No.	Risk Event	Low	Most Likely	High
PR-4	Lawsuit Risk	0.0 Months	0.0 Months	6.0 Months

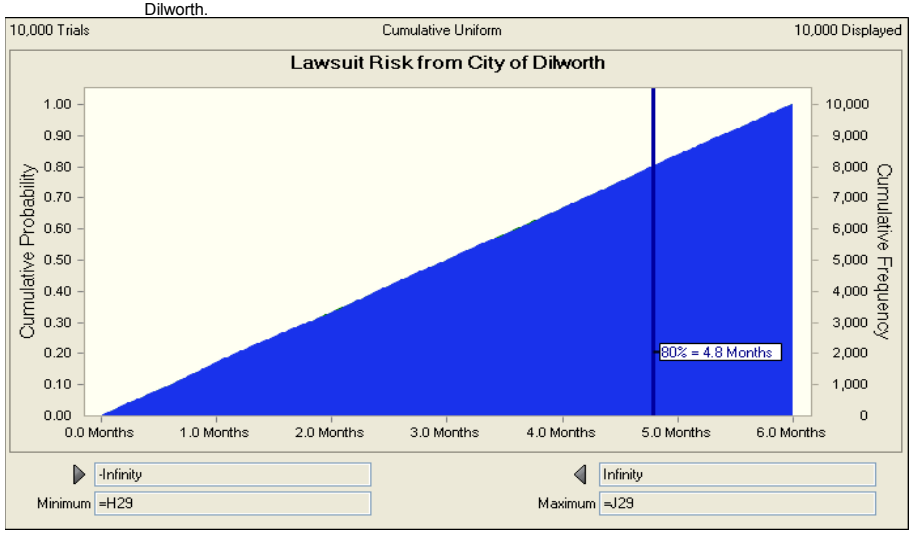
Notes: This item captures the risk that will cause a variance from the baseline schedule for the project.

Likely Likely assumes no change from the baseline schedule.

Low Assumes that project schedule will still be the baseline if there is not a lawsuit from Dilworth

High

Assumes that there will be a delay in the project schedule if there is a lawsuit from Dilworth.



Assumption: **Lawsuit Risk**

Percentile	Assumption values
0%	0.0 Months
10%	0.6 Months
20%	1.2 Months
30%	1.8 Months
40%	2.4 Months
50%	3.0 Months
60%	3.6 Months
70%	4.2 Months
80%	4.8 Months
90%	5.4 Months
100%	6.0 Months

MVP - Fargo/Moorhead Feasibility Report (Minnesota Option) - Schedule Risk Analysis Model

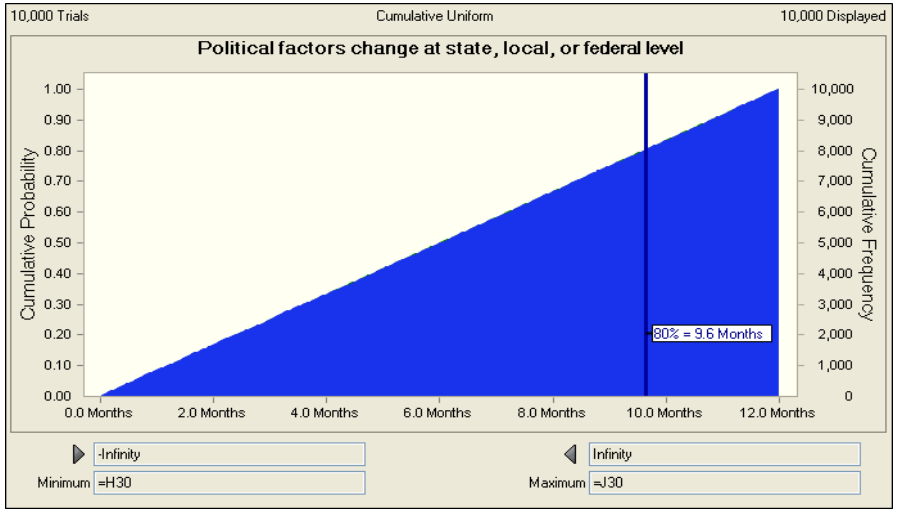
Risk Refer No.	Risk Event	Low	Most Likely	High
PR-5	Political factors change at state, local, or federal level	0.0 Months	0.0 Months	12.0 Months

Notes: This item captures the risk that will cause a variance from the baseline schedule for the project.

Likely Likely assumes no change from the baseline schedule.

Low Assumes the baseline schedule even if there are more favorable political changes and not any oppisition

High Assumes the political factors cause an increase from the baseline project schedule



Assumption: **Political factors change at state, local, or federal level**

Percentile	Assumption values
0%	0.0 Months
10%	1.2 Months
20%	2.4 Months
30%	3.6 Months
40%	4.8 Months
50%	6.0 Months
60%	7.2 Months
70%	8.4 Months
80%	9.6 Months
90%	10.8 Months
100%	12.0 Months

MVP - Fargo/Moorhead Feasibility Report (Minnesota Option) - Schedule Risk Analysis Model

Risk Refer No.	Risk Event	Low	Most Likely	High
PR-7	Lawsuit Risk from NGOs and Downstream Interests	0.0 Months	0.0 Months	12.0 Months

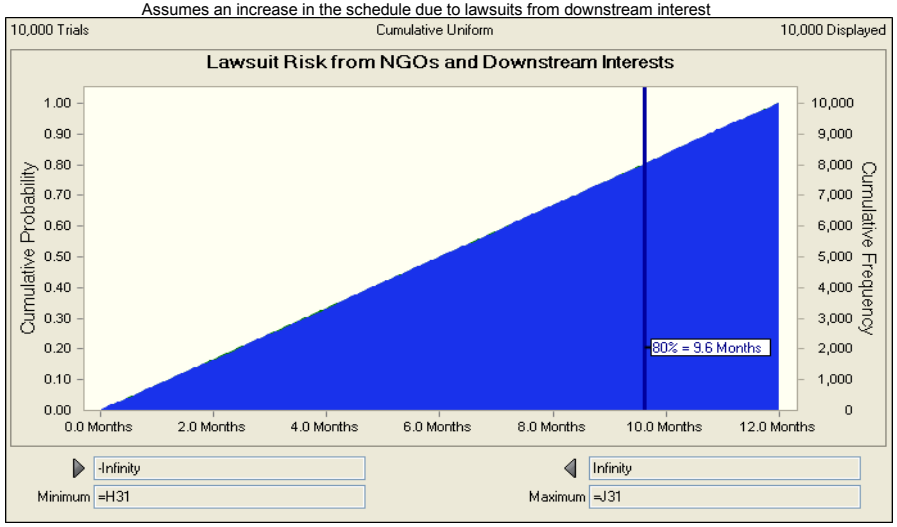
Notes: This item captures the risk that will cause a variance from the baseline schedule for the project.

Likely Likely assumes no change from the baseline schedule.

Low Assumes the baseline schedule when there are not any lawsuits from Downstream interest

High

Assumes an increase in the schedule due to lawsuits from downstream interest



Assumption: **Lawsuit Risk from NGOs and Downstream Interests**

Percentile	Assumption values
0%	0.0 Months
10%	1.2 Months
20%	2.5 Months
30%	3.7 Months
40%	4.8 Months
50%	6.0 Months
60%	7.2 Months
70%	8.4 Months
80%	9.6 Months
90%	10.8 Months
100%	12.0 Months

US Army Corps
of Engineers®

Fargo-Moorhead Metro Flood Risk Management Project, Feasibility Study, Phase 4

Locally Preferred Plan (LPP) – North Dakota Option

Project Cost and Schedule Risk Analysis Report

Prepared for:

U.S. Army Corps of Engineers,
St. Paul District

Prepared by:

U.S. Army Corps of Engineers
Cost Engineering Directory of Expertise, Walla Walla

May 2, 2011

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LIST OF APPENDICES

EXECUTIVE SUMMARY

Under the auspices of the US Army Corps of Engineers (USACE), St. Paul District, this report presents a recommendation for the project cost and schedule contingencies for the Fargo-Moorhead Metro Flood Risk Management Project, Feasibility Study, Phase 4 Locally Preferred Plan (LPP) – North Dakota Option (Fargo-Moorhead FRM LPP). In compliance with Engineer Regulation (ER) 1110-2-1302 CIVIL WORKS COST ENGINEERING, dated September 15, 2008, a formal risk analysis study was conducted for the development of contingency on the project cost. The purpose of this risk analysis study was to establish project contingencies by identifying and measuring the cost and schedule impact of project uncertainties with respect to the estimated project cost.

Specific to the Fargo-Moorhead LPP Project, the most likely project cost (at price level) is estimated at approximately $1.387 Billion. Based on the results of the analysis, the Cost Engineering Directory of Expertise for Civil Works (Walla Walla District) recommends a contingency value of $367 Million, or 26%. This contingency includes $279 Million (20%) for cost growth potential due to risk analyzed in the base cost estimate and $88 Million (6%) for cost growth potential due to risk analyzed in the baseline schedule.

Walla Walla Cost Dx performed risk analysis using the *Monte Carlo* technique, producing the aforementioned contingencies and identifying key risk drivers.

The following table ES-1 portrays the development of contingencies (26%). The contingency is based on an 80% confidence level, as per USACE Civil Works guidance.

Table ES-1. Contingency Analysis Table

Most Likely Cost Estimate	**$1,387,078,819**	
Confidence Level	**Value ($$)**	**Contingency (%)**
5%	$1,505,513,807	8.54%
50%	$1,660,870,979	19.74%
80%	**$1,754,275,887**	**26.47%**
95%	$1,840,932,008	32.72%

The following table ES-2 portrays the full costs of the recommended alternative based on the anticipated contracts. The costs are intended to address the congressional request of estimates to implement the project. The contingency is based on an 80% confidence level, as per accepted USACE Civil Works guidance.

Table ES-2. Cost Summary

FARGO-MOORHEAD LPP		COST ($1,000)	CNTG ($1,000)	TOTAL ($1,000)
01	LANDS AND DAMAGES	214,845	56,875	271,720
02	RELOCATIONS	119,480	31,630	151,110
06	FISH AND WILDLIFE FACILITIES	51,113	13,531	64,644
08	ROADS, RAILROADS, AND BRIDGES	46,497	12,309	58,807
09	CHANNELS AND CANALS	609,705	161,405	771,110
11	LEVEES AND FLOODWALLS	111,190	29,435	140,624
14	RECREATION FACILITIES	23,027	6,096	29,123
30	PLANNING, ENGINEERING AND DESIGN	144,015	38,125	182,140
31	CONSTRUCTION MANAGEMENT	67,207	17,792	84,999
	TOTAL PROJECT COSTS	**1,387,079**	**367,197**	**1,754,276**
	Schedule Completion with Contingency	**2 Apr 2020**	**117 months**	**17 Dec 2029**

Notes:
1) Costs include the recommended contingency of 26%.
2) Costs exclude O&M and Life Cycle Cost estimates.

KEY FINDINGS/OBSERVATIONS RECOMMENDATIONS

The key cost risk drivers identified through sensitivity analysis were Risks PR-6 (Lawsuit Risk from NGOs and Upstream Interests), PPM-8 (Scope Changes) and CON-6 (Contract Modifications), which together contribute 65 percent of the statistical cost variance. PR-6 captures the risk that there may be perceived damages by upstream interests and non-sponsor communities. PPM-8 captures the risk that changes to scope, as required by stakeholders, may increase the cost of the project. CON-6 captures the risk that there may be cost growth due to post-award modifications to the contracts due to differing site conditions, engineering changes, and/or claims.

The key schedule risk driver identified through sensitivity analysis was Risk PR-1 (Uncertainty with Funding Stream), which contributes 82 percent of the statistical schedule variance. PR-1 covers the risk that delay in obtaining necessary funding increments my significantly delay the project.

Recommendations, as detailed within the main report, include the implementation of cost and schedule contingencies, further iterative study of risks throughout the project life-cycle, potential mitigation throughout the PED phase, and proactive monitoring and control of risk identified in this study.

MAIN REPORT

1.0 PURPOSE

Under the auspices of the US Army Corps of Engineers (USACE), St. Paul District, this report presents a recommendation for the project cost and schedule contingencies for the Fargo-Moorhead Metro Flood Risk Management Project, Feasibility Study, Phase 4 Locally Preferred Plan (LPP) – North Dakota Option (Fargo-Moorhead FRM LPP).

2.0 BACKGROUND

The purpose of the Fargo-Moorhead Feasibility Study is to identify measures and develop a regional system to reduce flood risk along the Red River of the North for the entire Fargo-Moorhead metropolitan area. The study PDT collected, evaluated and screened an array of possible flood risk management plans to define the costs, benefits and impacts to the project area. The plans resulted in a diversion channel alternative as the best measures to reduce the flood risk. A diversion through Minnesota around the city of Moorhead offered the plan with the lowest cost having a B/C ratio over one. The local sponsors preferred a diversion alternative through North Dakota around the city of Fargo as a locally preferred plan. The PDT has developed plans and estimates for both the National Economic Development (NED) - Minnesota Plan and the LPP – North Dakota plan.

St. Paul District is preparing a Feasibility Report. As a part of this effort, St. Paul District requested that the USACE Cost Engineering Directory of Expertise for Civil Works (Cost Engineering Dx) provide an agency technical review (ATR) of the cost estimate and schedule for LRR. That tasking also included providing a risk analysis study to establish the resulting contingencies.

3.0 REPORT SCOPE

The scope of the risk analysis report is to calculate and present the cost and schedule contingencies at the 80 percent confidence level using the risk analysis processes, as mandated by U.S. Army Corps of Engineers (USACE) Engineer Regulation (ER) 1110-2-1150, Engineering and Design for Civil Works, ER 1110-2-1302, Civil Works Cost Engineering, and Engineer Technical Letter 1110-2-573, Construction Cost Estimating Guide for Civil Works. The report presents the contingency results for cost risks for all project features. The study and presentation does not include consideration for life cycle costs.

3.1 Project Scope

The formal process included extensive involvement of the PDT for risk identification and the development of the risk register. The analysis process evaluated the most likely Micro Computer Aided Cost Estimating System (MCACES) cost estimate, schedule, and funding profiles using Crystal Ball software to conduct a *Monte Carlo* simulation and statistical sensitivity analysis, per the guidance in Engineer Technical Letter (ETL) CONSTRUCTION COST ESTIMATING GUIDE FOR CIVIL WORKS, dated September 30, 2008.

The project technical scope, estimates and schedules were developed and presented by the St. Paul District. Consequently, these documents serve as the basis for the risk analysis.

The scope of this study addresses the identification of problems, needs, opportunities and potential solutions that are viable from an economic, environmental, and engineering viewpoint.

3.2 USACE Risk Analysis Process

The risk analysis process for this study follows the USACE Headquarters requirements as well as the guidance provided by the Cost Engineering Dx. The risk analysis process reflected within this report uses probabilistic cost and schedule risk analysis methods within the framework of the Crystal Ball software. Furthermore, the scope of the report includes the identification and communication of important steps, logic, key assumptions, limitations, and decisions to help ensure that risk analysis results can be appropriately interpreted.

Risk analysis results are also intended to provide project leadership with contingency information for scheduling, budgeting, and project control purposes, as well as to provide tools to support decision making and risk management as the project progresses through planning and implementation. To fully recognize its benefits, cost and schedule risk analysis should be considered as an ongoing process conducted concurrent to, and iteratively with, other important project processes such as scope and execution plan development, resource planning, procurement planning, cost estimating, budgeting and scheduling.

In addition to broadly defined risk analysis standards and recommended practices, this risk analysis was performed to meet the requirements and recommendations of the following documents and sources:

- Cost and Schedule Risk Analysis Process guidance prepared by the USACE Cost Engineering Dx.

- Engineer Regulation (ER) 1110-2-1302 CIVIL WORKS COST ENGINEERING, dated September 15, 2008.

- Engineer Technical Letter (ETL) CONSTRUCTION COST ESTIMATING GUIDE FOR CIVIL WORKS, dated September 30, 2008.

4.0 METHODOLOGY / PROCESS

The Cost Engineering Dx assembled a team, also relying on local St. Paul District staff to further augment labor, expertise and information gathering. The Cost Engineering Dx team consisted of one senior civil cost engineer.

The Cost Engineering Dx cost engineer facilitated a risk identification meeting on site with the St. Paul PDT on January 7, 2010. The initial risk identification meeting also included qualitative analysis to produce a risk register that served as the framework for the risk analysis. The cost and schedule risk models were completed and results reported on January 29, 2010. Several subsequent revisions to the estimates and risk analyses took place between January 29, 2010 and April 17, 2011. The final results were reported on April 17, 2011.

The risk analysis process for this study is intended to determine the probability of various cost outcomes and quantify the required contingency needed in the cost estimate to achieve any desired level of cost confidence.

In simple terms, contingency is an amount added to an estimate to allow for items, conditions or events for which the occurrence or impact is uncertain and that experience suggests will likely result in additional costs being incurred or additional time being required. The amount of contingency included in project control plans depends, at least in part, on the project leadership's willingness to accept risk of project overruns. The less risk that project leadership is willing to accept the more contingency should be applied in the project control plans. The risk of overrun is expressed, in a probabilistic context, using confidence levels.

The Cost Dx guidance for cost and schedule risk analysis generally focuses on the 80-percent level of confidence (P80) for cost contingency calculation. It should be noted that use of P80 as a decision criteria is a risk averse approach (whereas the use of P50 would be a risk neutral approach, and use of levels less than 50 percent would be risk seeking). Thus, a P80 confidence level results in greater contingency as compared to a P50 confidence level. The selection of contingency at a particular confidence level is ultimately the decision and responsibility of the project's District and/or Division management.

The risk analysis process uses *Monte Carlo* techniques to determine probabilities and contingency. The *Monte Carlo* techniques are facilitated computationally by a commercially available risk analysis software package (Crystal Ball) that is an add-in to Microsoft Excel. Cost estimates are packaged into an Excel format and used directly for cost risk analysis purposes. The level of detail recreated in the Excel-format schedule is sufficient for risk analysis purposes that reflect the established risk register, but generally less than that of the native format.

The primary steps, in functional terms, of the risk analysis process are described in the following subsections. Risk analysis results are provided in Section 6.

4.1 Identify and Assess Risk Factors

Identifying the risk factors via the PDT is considered a qualitative process that results in establishing a risk register that serves as the document for the quantitative study using the Crystal Ball risk software. Risk factors are events and conditions that may influence or drive uncertainty in project performance. They may be inherent characteristics or conditions of the project or external influences, events, or conditions such as weather or economic conditions. Risk factors may have either favorable or unfavorable impacts on project cost and schedule.

Formal PDT meetings were held for the purposes of identifying and assessing risk factors. The formal meeting conducted on January 7, 2010 included representatives from plan formulation, project management, geotechnical and hydraulic design, cost engineering, construction, environmental compliance, real estate, and the project sponsors.

The initial formal meetings focused primarily on risk factor identification using brainstorming techniques, but also included some facilitated discussions based on risk factors common to projects of similar scope and geographic location. Subsequent meetings focused primarily on risk factor assessment and quantification.

Additionally, numerous conference calls and informal meetings were conducted throughout the risk analysis process on an as-needed basis to further facilitate risk factor identification, market analysis, and risk assessment.

4.2 Quantify Risk Factor Impacts

The quantitative impacts of risk factors on project plans were analyzed using a combination of professional judgment, empirical data and analytical techniques. Risk factor impacts were quantified using probability distributions (density functions) because risk factors are entered into the Crystal Ball software in the form of probability density functions.

Similar to the identification and assessment process, risk factor quantification involved multiple project team disciplines and functions. However, the quantification process relied more extensively on collaboration between cost engineering and risk analysis team members with lesser inputs from other functions and disciplines. This process used an iterative approach to estimate the following elements of each risk factor:

- Maximum possible value for the risk factor
- Minimum possible value for the risk factor
- Most likely value (the statistical mode), if applicable
- Nature of the probability density function used to approximate risk factor uncertainty
- Mathematical correlations between risk factors
- Affected cost estimate and schedule elements

The resulting product from the PDT discussions is captured within a risk register as presented in section 6 for both cost and schedule risk concerns. Note that the risk register records the PDT's risk concerns, discussions related to those concerns, and potential impacts to the current cost and schedule estimates. The concerns and discussions support the team's decisions related to event likelihood, impact, and the resulting risk levels for each risk event.

4.3 Analyze Cost Estimate and Schedule Contingency

Contingency is analyzed using the Crystal Ball software, an add-in to the Microsoft Excel format of the cost estimate and schedule. *Monte Carlo* simulations are performed by applying the risk factors (quantified as probability density functions) to the appropriate estimated cost and schedule elements identified by the PDT. Contingencies are calculated by applying only the moderate and high level risks identified for each option (i.e., low-level risks are typically not considered, but remain within the risk register to serve historical purposes as well as support follow-on risk studies as the project and risks evolve).

For the cost estimate, the contingency is calculated as the difference between the P80 cost forecast and the baseline cost estimate. Each option-specific contingency is then allocated on a civil works feature level based on the dollar-weighted relative risk of each feature as quantified by *Monte Carlo* simulation. Standard deviation is used as the feature-specific measure of risk for contingency allocation purposes. This approach results in a relatively larger portion of all the project feature cost contingency being allocated to features with relatively higher estimated cost uncertainty.

5.0 PROJECT ASSUMPTIONS

The following data sources and assumptions were used in quantifying the costs associated with the Fargo-Moorhead LPP project.

a. The St. Paul District provided MII MCACES (Micro-Computer Aided Cost Estimating Software) files via email. The file title, "MVP LPP_ND_Diversion_Phase_4 with 2009 Equip Rate.mlp" was the basis for the cost and schedule risk analyses.

b. The cost comparisons and risk analyses performed and reflected within this report are based on design scope and estimates that are at the feasibility level.

c. Schedules are analyzed for impact to the project cost in terms of both uncaptured escalation (variance from OMB factors and the local market) and unavoidable fixed contract costs and/or languishing federal administration costs incurred throughout delay.

d. Per the CWCCIS Historical State Adjustment Factors in EM 1110-2-1304, State Adjustment Factors for Minnesota and North Dakota are 1.15 and 0.92, respectively. Taking this into account along with the historical RS Means labor inflation rate and Consumer Price Index (CPI) factor for Minnesota, the average suggests that true inflation is approximately 4.55% higher for the Fargo Metro area than for the national average. This rate was used to calculate the differential between the local market and OMB inflation factors for future construction. For the P80 schedule, this is approximately 1.59% of the contingency.

e. Per the data in the estimate, the Job Office Overhead (JOOH) amount comprises approximately 5% of the Project Cost at Baseline. Thus, the assumed residual fixed cost rate for this project is 5%. For the P80 schedule, this comprises approximately 4.77% of the total contingency due to the accrual of residual fixed costs associated with delay.

f. The Cost Dx guidance generally focuses on the eighty-percent level of confidence (P80) for cost contingency calculation. For this risk analysis, the eighty-percent level of confidence (P80) was used. It should be noted that the use of P80 as a decision criteria is a moderately risk averse approach, generally resulting in higher cost contingencies. However, the P80 level of confidence also assumes a small degree of risk that the recommended contingencies may be inadequate to capture actual project costs.

g. Only high and moderate risk level impacts, as identified in the risk register, were considered for the purposes of calculating cost contingency. Low level risk impacts should be maintained in project management documentation, and reviewed at each project milestone to determine if they should be placed on the risk "watch list".

6.0 RESULTS

The cost and schedule risk analysis results are provided in the following sections. In addition to contingency calculation results, sensitivity analyses are presented to provide decision makers with an understanding of variability and the key contributors to the cause of this variability.

6.1 Risk Register

A risk register is a tool commonly used in project planning and risk analysis. The actual risk register is provided in Appendix A. The complete risk register includes low level risks, as well as additional information regarding the nature and impacts of each risk.

It is important to note that a risk register can be an effective tool for managing identified risks throughout the project life cycle. As such, it is generally recommended that risk registers be updated as the designs, cost estimates, and schedule are further refined, especially on large projects with extended schedules. Recommended uses of the risk register going forward include:

- Documenting risk mitigation strategies being pursued in response to the identified risks and their assessment in terms of probability and impact.
- Providing project sponsors, stakeholders, and leadership/management with a documented framework from which risk status can be reported in the context of project controls.
- Communicating risk management issues.
- Providing a mechanism for eliciting feedback and project control input.
- Identifying risk transfer, elimination, or mitigation actions required for implementation of risk management plans.

6.2 Cost Contingency and Sensitivity Analysis

Table 1 provides the construction cost contingencies calculated for the P80 confidence level and rounded to the nearest thousand. The construction cost contingencies for the P50 and P100 confidence levels are also provided for illustrative purposes only.

Contingency was quantified as approximately $367 Million at the P80 confidence level (26% of the baseline cost estimate). For comparison, the cost contingency at the P50 and P100 confidence levels was quantified as 20% and 47% of the baseline cost estimate, respectively.

Table 1. Project Cost Contingency Summary

Risk Analysis Forecast	Baseline Estimate	Total Contingency[1,2] ($)	Total Contingency (%)
50% Confidence Level			
Project Cost	$1,660,870,979	$273,792,160	19.74%
80% Confidence Level			
Project Cost	$1,754,275,887	$367,197,067	26.47%
100% Confidence Level			
Project Cost	$2,040,970,710	$653,891,891	47.14%

Notes:
1) These figures combine uncertainty in the baseline cost estimates and schedule.
2) A P100 confidence level is an abstract concept for illustration only, as the nature of risk and uncertainty (specifically the presence of "unknown unknowns") makes 100% confidence a theoretical impossibility.

6.2.1 Sensitivity Analysis

Sensitivity analysis generally ranks the relative impact of each risk/opportunity as a percentage of total cost uncertainty. The Crystal Ball software uses a statistical measure (contribution to variance) that approximates the impact of each risk/opportunity contributing to variability of cost outcomes during *Monte Carlo* simulation.

Key cost drivers identified in the sensitivity analysis can be used to support development of a risk management plan that will facilitate control of risk factors and their potential impacts throughout the project lifecycle. Together with the risk register, sensitivity analysis results can also be used to support development of strategies to eliminate, mitigate, accept or transfer key risks.

6.2.2 Sensitivity Analysis Results

The risks/opportunities considered as key or primary cost drivers are ranked in order of importance in contribution to variance bar charts. Opportunities that have a potential to reduce project cost and are shown with a negative sign; risks are shown with a positive sign to reflect the potential to increase project cost. A longer bar in the sensitivity analysis chart represents a greater potential impact to project cost.

Figure 1 presents a sensitivity analysis for cost growth risk from the high level cost risks identified in the risk register. Likewise, Figure 2 presents a sensitivity analysis for schedule growth risk from the high level schedule risks identified in the risk register.

6.3 Schedule and Contingency Risk Analysis

Table 2 provides the schedule duration contingencies calculated for the P80 confidence level. The schedule duration contingencies for the P50 and P100 confidence levels are also provided for illustrative purposes.

Schedule duration contingency was quantified as 117 months based on the P80 level of confidence. These contingencies were used to calculate the projected residual fixed cost impact of project delays that are included in the Table 1 presentation of total cost contingency. The schedule contingencies were calculated by applying the high level schedule risks identified in the risk register for each option to the durations of critical path and near critical path tasks.

The schedule was not resource loaded and contained open-ended tasks and non-zero lags (gaps in the logic between tasks) that limit the overall utility of the schedule risk analysis. These issues should be considered as limitations in the utility of the schedule contingency data presented. Schedule contingency impacts presented in this analysis are based solely on projected residual fixed costs.

Table 2. Schedule Duration Contingency Summary

Risk Analysis Forecast	Baseline Schedule Duration (months)	Contingency[1] (months)
50% Confidence Level		
Project Duration	122	74
80% Confidence Level		
Project Duration	122	95
100% Confidence Level		
Project Duration	122	176

Notes:
1) The schedule was not resource loaded and contained open-ended tasks and non-zero lags (gaps in the logic between tasks) that limit the overall utility of the schedule risk analysis. These issues should be considered as limitations in the utility of the schedule contingency data presented in Table 2.
2) A P100 confidence level is an abstract concept for illustration only, as the nature of risk and uncertainty (specifically the presence of “unknown unknowns”) makes 100% confidence a theoretical impossibility.

Figure 1. Cost Sensitivity Analysis

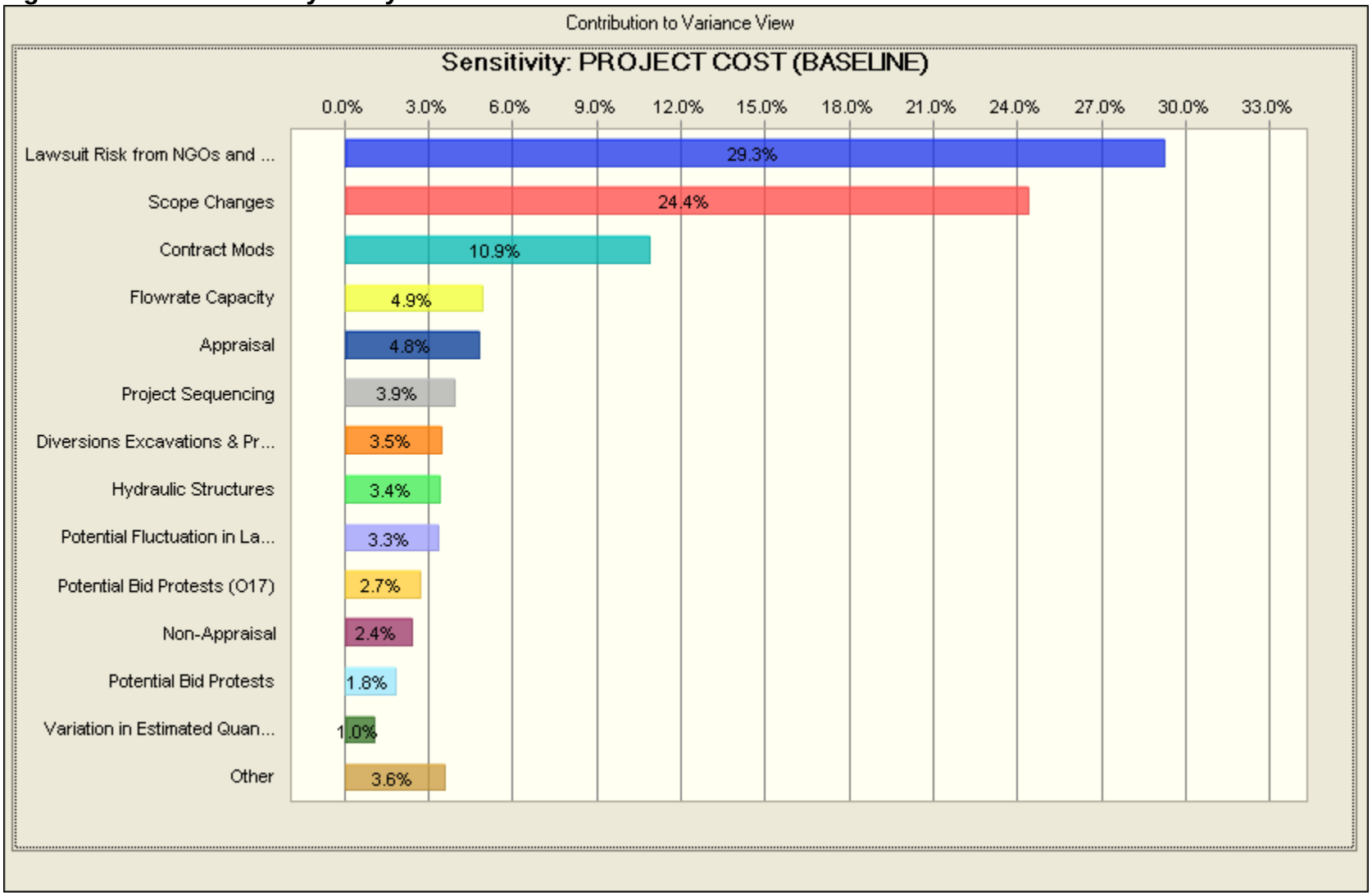
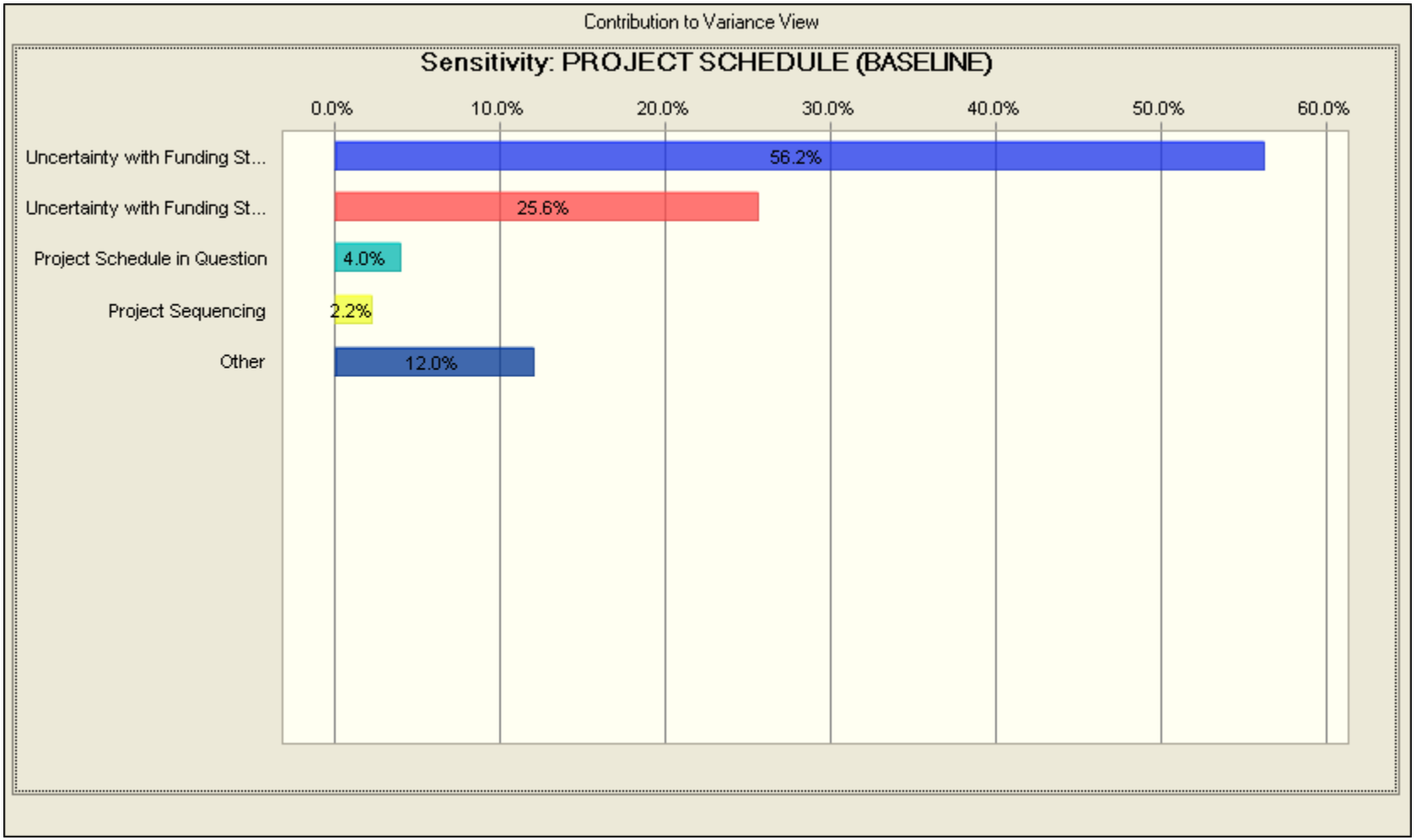


Figure 2. Schedule Sensitivity Analysis



7.0 MAJOR FINDINGS/OBSERVATIONS/RECOMMENDATIONS

This section provides a summary of significant risk analysis results that are identified in the preceding sections of the report. Risk analysis results are intended to provide project leadership with contingency information for scheduling, budgeting, and project control purposes, as well as to provide tools to support decision making and risk management as projects progress through planning and implementation. Because of the potential for use of risk analysis results for such diverse purposes, this section also reiterates and highlights important steps, logic, key assumptions, limitations, and decisions to help ensure that the risk analysis results are appropriately interpreted.

7.1 Major Findings/Observations

Project cost comparison summaries are provided in Table 3 and Figure 3. Additional major findings and observations of the risk analysis are listed below.

1. The key cost risk drivers identified through sensitivity analysis were Risks PR-6 (Lawsuit Risk from NGOs and Upstream Interests), PPM-8 (Scope Changes) and CON-6 (Contract Modifications), which together contribute 65 percent of the statistical cost variance.

2. The key schedule risk driver identified through sensitivity analysis was Risk PR-1 (Uncertainty with Funding Stream), which contributes 82 percent of the statistical schedule variance.

3. Operation and maintenance activities were not included in the cost estimate or schedules. Therefore, a full lifecycle risk analysis could not be performed. Risk analysis results or conclusions could be significantly different if the necessary operation and maintenance activities were included.

Table 3. Project Cost Comparison Summary

Confidence Level	Project Cost ($)	Contingency (%)
P0	**$1,339,855,676**	**-3.40%**
P5	**$1,505,513,807**	**8.54%**
P10	**$1,538,269,944**	**10.90%**
P15	**$1,560,810,805**	**12.53%**
P20	**$1,577,802,468**	**13.75%**
P25	**$1,593,278,637**	**14.87%**
P30	**$1,607,580,440**	**15.90%**
P35	**$1,621,111,138**	**16.87%**
P40	**$1,634,694,783**	**17.85%**
P45	**$1,647,129,777**	**18.75%**
P50	**$1,660,870,979**	**19.74%**
P55	**$1,674,604,577**	**20.73%**
P60	**$1,688,826,432**	**21.75%**
P65	**$1,703,289,774**	**22.80%**
P70	**$1,719,421,608**	**23.96%**
P75	**$1,735,440,729**	**25.11%**
P80	**$1,754,275,887**	**26.47%**
P85	**$1,775,988,250**	**28.04%**
P90	**$1,802,415,619**	**29.94%**
P95	**$1,840,932,008**	**32.72%**
P100	**$2,040,970,710**	**47.14%**

Figure 3. Project Cost Summary

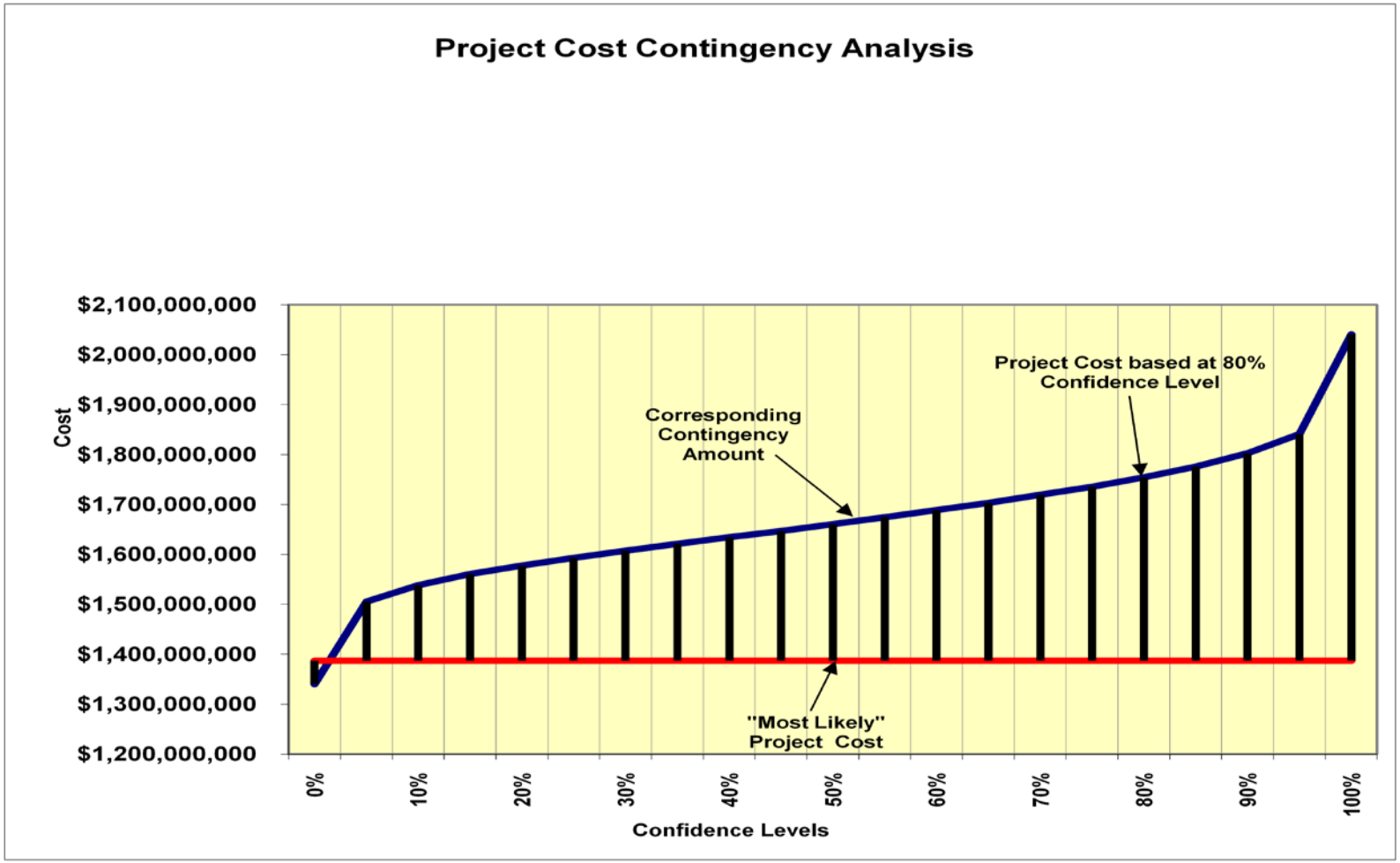
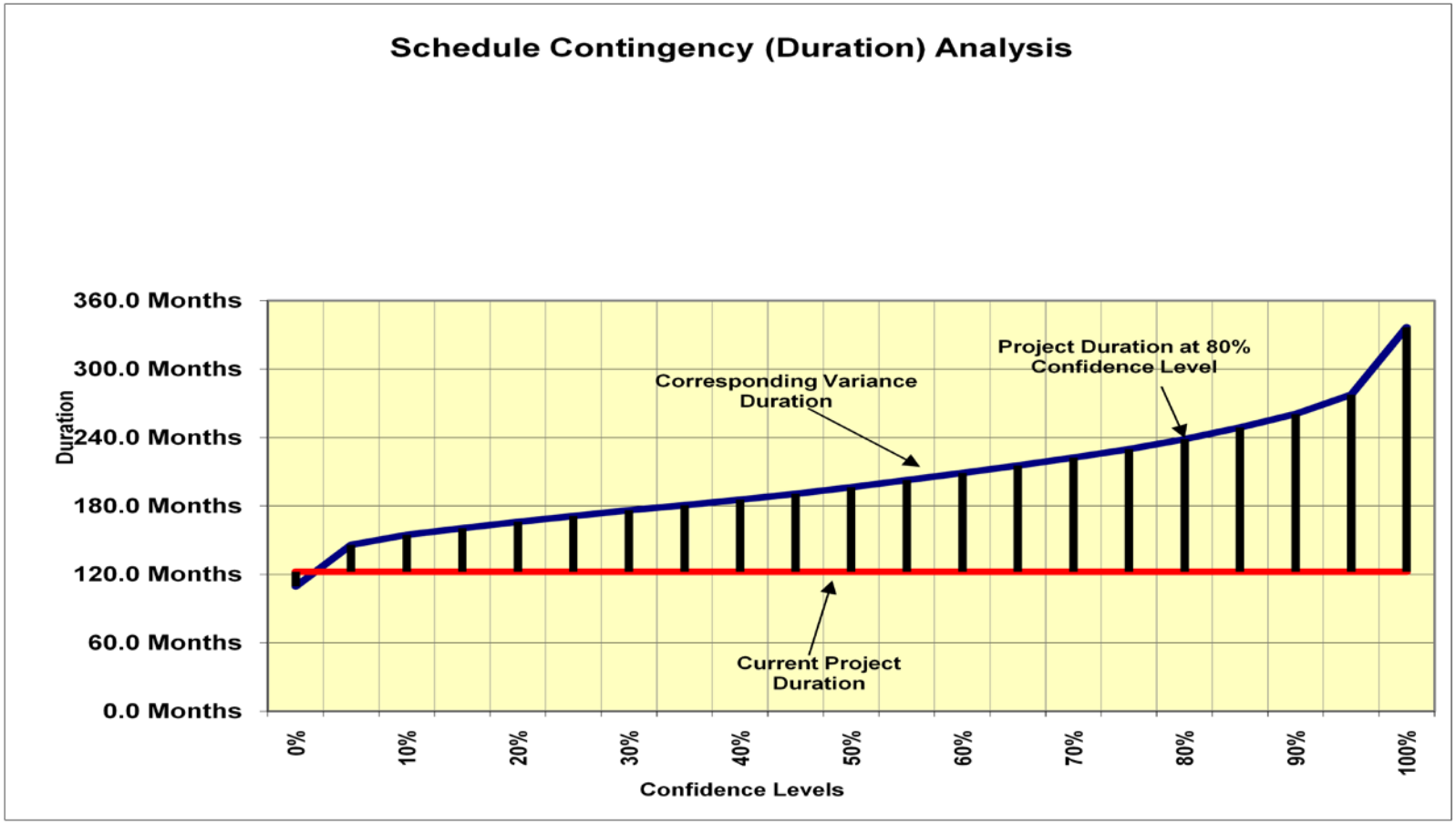


Figure 4. Project Duration Summary



7.2 Recommendations

Risk Management is an all-encompassing, iterative, and life-cycle process of project management. The Project Management Institute's (PMI) *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*, *4th edition*, states that "project risk management includes the processes concerned with conducting risk management planning, identification, analysis, responses, and monitoring and control on a project." Risk identification and analysis are processes within the knowledge area of risk management. Its outputs pertinent to this effort include the risk register, risk quantification (risk analysis model), contingency report, and the sensitivity analysis.

The intended use of these outputs is implementation by the project leadership with respect to risk responses (such as mitigation) and risk monitoring and control. In short, the effectiveness of the project risk management effort requires that the proactive management of risks not conclude with the study completed in this report.

The Cost and Schedule Risk Analysis (CSRA) produced by the PDT identifies issues that require the development of subsequent risk response and mitigation plans. This section provides a list of recommendations for continued management of the risks identified and analyzed in this study. Note that this list is not all inclusive and should not substitute a formal risk management and response plan.

1. Key Cost Risk Drivers: The key cost risk drivers identified through sensitivity analysis were Risks PR-6 (Lawsuit Risk from NGOs and Upstream Interests), PPM-8 (Scope Changes) and CON-6 (Contract Modifications), which together contribute 65 percent of the statistical cost variance.

a) Lawsuit Risk from NGOs and Upstream Interests: Project leadership should take proactive measures to obtain decisions as well as collect information regarding upstream interests. Project leadership should also communicate to management regarding the impact of these issues on cost performance. Ultimately, this is an external risk, and its impacts must be communicated to management, and funds should be maintained in project reserve for treatment of this risk.

b) Scope Changes: Project leadership should attempt to capture and finalize the scope of the project to the maximum extent possible. It is imperative to identify all features of work and probable methodologies, along with the accompanying risks associated with implementation. Iterative quantification (risk analysis) may be necessary to further develop and pinpoint sources of risk to identify needs for risk treatment in the risk response and management plan.

c) Contract Modifications: Project leadership should attempt to capture and finalize the scope of the project to the maximum extent possible. It is imperative to identify all features of work and probable methodologies, along with the accompanying risks associated with implementation. Iterative quantification (risk

analysis) may be necessary to further develop and pinpoint sources of risk to identify needs for risk treatment in the risk response and management plan. Additionally, project leadership should determine acquisition strategy and make decisions early to impact the completion of contract documents as to minimize risk of engineering changes and potential claims.

2. Key Schedule Risk Drivers: The key schedule risk driver identified through sensitivity analysis was Risk PR-1 (Uncertainty with Funding Stream), which contributes 82 percent of the statistical schedule variance.

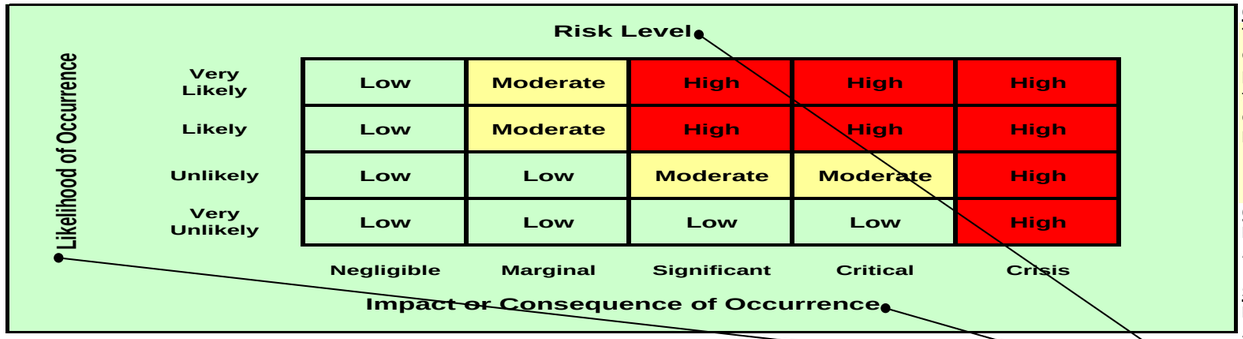
a) Uncertainty with Funding Stream: Project leadership should project leadership proactively develop accurate funding profile projections to capture probable funding requirements. Ultimately, this is an external risk, and its impacts must be communicated to management.

3. Risk Management: Project leadership should use of the outputs created during the risk analysis effort as tools in future risk management processes. The risk register should be updated at each major project milestone. The results of the sensitivity analysis may also be used for response planning strategy and development. These tools should be used in conjunction with regular risk review meetings.

4. Risk Analysis Updates: Project leadership should review risk items identified in the original risk register and add others, as required, throughout the project life-cycle. Risks should be reviewed for status and reevaluation (using qualitative measure, at a minimum) and placed on risk management watch lists if any risk's likelihood or impact significantly increases. Project leadership should also be mindful of the potential for secondary (new risks created specifically by the response to an original risk) and residual risks (risks that remain and have unintended impact following response).

APPENDIX A

MVP - Fargo/Moorhead Feasibility Report (LPP - North Dakota Option) - PDT Risk Register



Overall Project Scope

The Fargo-Moorhead Feasibility Study purpose is to identify measures and develop a regional system to reduce flood risk along the Red River of the North for the entire F-M metroploitan area. The study PDT collected, evaluated and screened an array of possible flood risk management plans to define the costs, benefits and impacts to the project area. The plans resulted in a diversion channel alternative as the best measures to reduce the flood risk. A diversion through Minnesota around the city of Moorhead offered the plan with the lowest cost having a B/C ratio over one. The local sponsors preferred a diversion alternative through North Dakota around the city of Fargo as a locally preferred plan. The PDT has developed plans and estimates for both the MN Plan and the LPP ND plan.

Cost Impacts

For the Fargo/Moorhead Project, any cost impact of $10 Million or higher should be considered at least "Significant."
Anything over $5 Million should be considered at least "Marginal."

Schedule Impacts

For the Fargo/Moorhead Project, any schedule impact of 12 months or greater should be considered at least "Significant."
Anything over 6 months should be considered at least "Marginal."

Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions	Project Cost				Project Schedule				Variance Distribution	Correlation to Other(s)	Responsibility/POC	Affected Project Component
				Likelihood*	Impact*	Risk Level*	Rough Order Impact ($)	Likelihood*	Impact*	Risk Level*	Rough Order Impact (mo)				
	Contract Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)														
	PROJECT & PROGRAM MGMT														
PPM-1	Project Schedule in Question	Due to the size and magnitude of the project, as well as the complexity of the structures and sequencing, there is inherent concern regarding the actual project schedule.	This could cause a variance in the project schedule (positive or negative, but most likely negative).	Likely	Significant	High		Likely	Marginal	Moderate		Uniform		Project Manager	Project Cost & Schedule
PPM-2	Accelerated Design Schedule	An accelerated schedule can result in inadequate studies, shortcuts in plans, change in contract acquisition strategy, failure to capture full scope, miss-steps, etc. There is the potential of moving forward with limited information.	The issue is covered in other risk events.	Likely	Significant	High		Likely	Significant	High		Triangular		District Management	Project Cost & Schedule
PPM-3	Unplanned Work that Must be Accommodated	Due to the preliminary stage of project development, there is potential that there may be features or subfeatures of work that must be added to construction. Ice handling and sediment transport are the two most likely issues that must be accommodated. There may also be mitigation requirements.	Most of these subfeatures are already captured in the design and estimate, but the configuration may change.	Likely	Marginal	Moderate		Likely	Marginal	Moderate		Yes-No		Project Manager	Project Cost & Schedule
PPM-4	Local Agency/Regulator Issues	The acceleration of the planning schedule has forced reviews and collaboration without much time given to local agencies and regulators. Although there has been communication between the Government and the local agencies, these agencies have not responded with definitive decisions. This could present potential impacts.	Eash of the agencies have provided formal comments and identified areas of concern, The design has been modified from when this concern was initially identified to increase the flows into the protected areas as coordinated with the agencies. This could impact cost and schedule.	Likely	Marginal	Moderate		Likely	Marginal	Moderate		Yes-No		Project Manager	Project Cost & Schedule
PPM-7	Conflicting Priorities	The District's workload and competing priorities may impede progress on this project related to staff availability and experience, related to design, investigations, contract procurements, construction management.	Since the identity of this concern, the F-M project has been identified as a high priority regional project , and barring a major national disater the F-M project will have all the resources it should need. Unlikely to cause cause any variance in the cost or schedule.	Unlikely	Negligible	Low		Unlikely	Negligible	Low		Uniform		District Management	Project Schedule
PPM-8	Scope Changes	The many competing interests & priorities, coupled with an accelerated schedule could result in scope changes currently uncaptured or unanticipated. These scope changes would require additional coordination, cause further design and investigation and potentially impact the real estate acquisitions.	While minor alterations to the final alignment may occur, there should not be any major changes.	Likely	Marginal	Moderate		Likely	Significant	High		Yes-No		Project Manager	Project Cost & Schedule
	CONTRACT ACQUISITION RISKS														

Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions	Project Cost				Project Schedule				Variance Distribution	Correlation to Other(s)	Responsibility/POC	Affected Project Component
				Likelihood*	Impact*	Risk Level*	Rough Order Impact ($)	Likelihood*	Impact*	Risk Level*	Rough Order Impact (mo)				
CA-1	Undefined Acquisition Strategy	The overall acquisition strategy for both design and construction has not been defined. Acquisition strategy could affect/impact bid competition and bid costs. It can also move risk onto the Government, causing need for greater contingencies. Clarification should be made related to number of contracts, contract types, etc. authority for this procurement.	Acquisition stratagy needs to be defined and could impact the cost and schedule.	Likely	Marginal	Moderate		Unlikely	Marginal	Low		Triangular		TASB	Contract Cost & Project Schedule
CA-2	Preference to Small Business	Most of the larger requirements are so large that they would not be suitable for small business. However, there is potential for some of the restoration, seeding, and mitigation may be suitable for small business. There is a requirement for review by the PARC if the requirements were less than $50 Million.	The project is so large, it is likely that even separable requirements would not be suitable for small business. Could impact cost and schedule.	Unlikely	Marginal	Low		Unlikely	Marginal	Low		Triangular		Contracting	Contract Cost & Project Schedule
CA-3	Numerous Separate Contracts	There is potential to have numerous separate contracts, especially if the continuing contracts authority is not granted. Funding stream issues could also have an impact on the number of contracts.	The best case would be 8 contracts. The worst case would be in excess of 12 contracts. More contracts could increase bidding competition. This could have a significant effect on cost and schedule (either positive or negative).	Very Likely	Significant	High		Unlikely	Marginal	Low		Triangular		Contracting	Contract Cost
CA-4	Potential Bid Protests	The larger size of the project increase contractor interests in bidding, but also increases potntial risk for protets due to hungry economy and interest in obtaining project dollars.	This could impact cost and schedule.	Likely	Marginal	Moderate		Likely	Marginal	Moderate		Yes-No		Contracting	Contract Cost
	TECHNICAL RISKS														
TL-1	Uncertainty with Geotechnical Conditions	There is uncertainty with geotechnical conditions but the Phase 4 estimate uses recent borings from 2010 to help define the the soil parameters for excavation and bearing capacity and how that will impact the construction productivity. The material is all clay and silt.	The current working estimate is fairly conservative. However, variation in the ultimate characterization of material could cause significant variance in productivity. Could impact cost and schedule (more likely positive than negative).	Likely	Marginal	Moderate		Likely	Marginal	Moderate		Triangular		Geotechnical/Civil Design	Contract Cost & Project Schedule
TL-2	Survey Data Incomplete	The PDT currently has incomplete or outdated survey data (for bathymetry for the Red River and Tributaries).	If the survey data uncovers data that differs greatly from current conceptual design, it could lead to variance in cost (due to issues such as configuration and details for structures). More likely on ND side.	Unlikely	Marginal	Low		Unlikely	Negligible	Low		Triangular		Technical Lead	Contract Cost & Project Schedule
TL-3	Maple Diversion Structure Concerns	Under very high flood events, water flows over and under the diversion structure. This could present issues, as this an unusual technical approach.	With the revised Phase 4 flow this structure does not submerge anymore and is not as much of a concern.	Unlikely	Marginal	Low		Unlikely	Marginal	Low		Yes-No		Hydrology/Hydraulic Design	Contract Cost & Project Schedule
TL-4	Sedimentation Modeling	The sedimentation modeling could show that higher flow accommodation may be necessary in the tributary structures.	This issue is more likely on Wild Rice, but not as likely on the Sheyenne or the Maple. This could impact cost and schedule.	Unlikely	Significant	Moderate		Unlikely	Negligible	Low		Yes-No		Hydrology/Hydraulic Design	Contract Cost
TL-5	Variation in Estimated Quantities	There is potential for variation of estimated quantities in the excavation and earthwork features.	This could impact cost and schedule.	Likely	Significant	High		Likely	Marginal	Moderate		Yes-No		Hydrology/Hydraulic Design	Contract Cost
TL-6	Flowrate Capacity	If during detailed design the hydraulics change, it could affect the amount of flow required for the diversion channel to handle. This would affect channel width, bridge lengths and major hydraulic structure sizes	This could impact cost and schedule.	Likely	Marginal	Moderate		Likely	Marginal	Moderate		Yes-No		Hydrology/Hydraulic Design	Project Cost & Schedule
TL-7	Relocations - Utilities	Quality of design at budget level	Most costs were obtained from affected utilities for the major lines that are impacted.	Likely	Marginal	Moderate		Unlikely	Negligible	Low		Triangular		Cost Engineering	Contract Cost
TL-8	Relocations - Bridges	Bridge costs will change depending on final diversion channel width	Bridge costs from historical DOT costs are fairly reliable.	Likely	Marginal	Moderate		Unlikely	Negligible	Low		Triangular		Cost Engineering	Contract Cost
TL-9	Mitigation	fish, wetlands, forest, adaptive management issues	Resource agencies have not agreed to any particular features yet so there is the potential for additional mitigation beyond what is proposed, though the Corps has laid out a well planned approach to mitigating the issues	Likely	Significant	High		Likely	Negligible	Low		Uniform		Environmental Compliance	Project Cost
TL-10	Railroad Bridges	RR Bridge sizes have changed since the initial RR bridge estimates and the costs have been scaled	Bridge costs from BNSF's consulting engineer are at conceptual design and cost could have significant changes	Likely	Significant	High		Unlikely	Marginal	Low		Triangular		Structural Design	Project Cost
TL-11	Diversions Excavations & Productivity	Excavations could be impacted by diversion alignment changes, productivity and/or model results	Impacts should only affect quantities of different soil layers	Likely	Marginal	Moderate		Likely	Marginal	Moderate		Triangular		Technical Lead	Contract Cost
TL-12	Hydraulic Structures	Hydraulic structures will need to be modeled	Model results could change design concepts	Likely	Significant	High		Likely	Marginal	Moderate		Triangular		Hydrology/Hydraulic Design	Contract Cost & Project Schedule

Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions	Project Cost				Project Schedule				Variance Distribution	Correlation to Other(s)	Responsibility/POC	Affected Project Component
				Likelihood*	Impact*	Risk Level*	Rough Order Impact ($)	Likelihood*	Impact*	Risk Level*	Rough Order Impact (mo)				
TL-13	Levees	Levee heights and lengths could change depending on if upstream staging is incorporated	Levees for upstream staging may depend on model studies and landowner oppisition	Likely	Marginal	Moderate		Likely	Marginal	Moderate		Triangular		Hydrology/Hydraulic Design	Contract Cost & Project Schedule
TL-14	Non-Structural Floodproofing	Costs for downstream impacts could change when the effects of have been fully developed	With Phase 4 LPP design with the upstream staging, there should not be any downstream impacts.	Unlikely	Negligible	Low		Unlikely	Marginal	Low		Triangular		Technical Lead	Project Cost
TL-15	Recreational Facilities	Feasibility is at conceptual design	Fnial designs could look different than Feasibility but overall concepts should be similar	Likely	Marginal	Moderate		Unlikely	Marginal	Low		Triangular		Cost Engineering	Contract Cost
TL-16	Fuel Cost Concerns	Volatility in the price of fuel	Recent spikes in fuel could increase the cost of fule for the project. Conversely, if the world markets calm down, fuel could return to a price lower that currently estimatesd in the project.	Likely	Significant	High		Unlikely	Marginal	Low		Triangular		Cost Engineering	Contract Cost
	LANDS AND DAMAGES RISKS														
LD-1	Mitigation Needs Identified for Upstream Impacts due to staging	The effects of the project on areas upstream may require mitigation footprint that has not been finalized. The impacts may not be fully captured.	This could significantly impact costs depending on final staging area configuration. It could significantly impact schedule.	Likely	Significant	High		Likely	Significant	High		Yes-No		Real Estate	Project Cost & Schedule
LD-2	Potential Savings for Eliminating RR Bridge 4	Currently, the RRVW RR has limited use of this line and indicated that abandonement is possible	This could save the cost of bridge and track raise	Likely	Significant	High		Very Unlikely	Negligible	Low		Yes-No		Project Manager	Project Cost & Schedule
LD-4	Appraisal	Appraisals carry certain assumptions based on technical information. If the techncial information has the potential to change, the appraisals could be impacted.	Appraisals are using an average value	Likely	Significant	High		Likely	Marginal	Moderate		Triangular		Real Estate	Project Cost
LD-5	Non-Appraisal	Real Estate office is responsible for establishing contingencies. There could be risks outside their domain that can still impact the costs.	Real Estate has identified $29M in recapture cost that the sponsor could recoup on the Lands & Damages estimate. Real Estate office will be using the CSRA contingencies	Likely	Significant	High		Likely	Marginal	Moderate		Triangular		Real Estate	Project Cost
	REGULATORY AND ENVIRONMENTAL RISKS														
RE-1	Environmental Mitigation Feature Concerns	The PDT has estimated mitigation features for Phase 4 based on the expected impacts (to include construction and real estate).	This could impact the costs either positively or negatively.	Likely	Marginal	Moderate		Very Unlikely	Negligible	Low		Triangular		Environmental Compliance	Project Cost
RE-2	Historical Cultural Resource Issues	There is potential to find cultural resources, particularly on the riverbanks. No cultural resource survey has been completed to date. Mitigiation will probably be necessary.	Could impact cost.	Very Likely	Negligible	Low		Unlikely	Marginal	Low		Triangular		Environmental Compliance	Project Cost
RE-3	HTRW Issues	There is some potential for discovery of HTRW in the project alignment. Most of the alignment is through farmland.	Any HTRW issues likely to be minor associated with farm chemicals	Unlikely	Marginal	Low		Unlikely	Negligible	Low		Uniform		Environmental Compliance	Project Cost & Schedule
RE-4	Fish Passage Issues	There will be fish passage requirement in the project, but the actual configuration has not been finalized/agreed upon by the local agencies.	Could impact cost of fish passage structures at assoicated structures	Likely	Marginal	Moderate		Unlikely	Negligible	Low		Triangular		Technical Lead	Project Cost
RE-5	Pressure to Compress Permitting Activities	The local agencies perceive that they are being pressured through the project permitting process.	PDT has programmed this into the schedule, and the agencies are not constricted more than normal review times.	Very Unlikely	Negligible	Low		Unlikely	Negligible	Low		Uniform		Environmental Compliance	Project Cost & Schedule

Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions	Project Cost				Project Schedule				Variance Distribution	Correlation to Other(s)	Responsibility/POC	Affected Project Component
				Likelihood*	Impact*	Risk Level*	Rough Order Impact ($)	Likelihood*	Impact*	Risk Level*	Rough Order Impact (mo)				
	CONSTRUCTION RISKS														
CON-1	Unknown Residential Utility Conflicts	There is potential for the need to abandon some small residential utilities.	This could impact cost and schedule, but it would be negligible.	Likely	Negligible	Low		Unlikely	Negligible	Low		Triangular		Technical Lead	Contract Cost & Project Schedule
CON-2	Control and Diversion of Water	Methodology of controlling water could be impacted by the sequencing and timing of relocation, the characterization of materials, or other unknown impacts.	Could impact cost and schedule.	Likely	Significant	High		Unlikely	Marginal	Low		Triangular		Technical Lead	Contract Cost
CON-3	Conflicts between Contractors	There is potential for conflicts between multiple contractors working in the same footprint at the same time.	Could impact cost. However, careful planning of the construction scheduling and sequencing should be able to avoid any major conflicts.	Likely	Negligible	Low		Unlikely	Negligible	Low		Triangular		Construction	Contract Cost & Project Schedule
CON-4	Sufficient QA Staff	to manage numerous contracts, mods and claims	ED-C is well aware of QA staffing issues and is planning accordingly	Unlikely	Marginal	Low		Unlikely	Negligible	Low		Triangular		Construction	Contract Cost & Project Schedule
CON-5	Project Sequencing	conflicts between contractors and schedule impacts (one contractor waiting on another)	Conficts may develop at reaches interface, building of bridges or hydraulic structures	Likely	Significant	High		Likely	Marginal	Moderate		Uniform		Construction	Project Cost & Schedule
CON-6	Contract Mods	Contract mods and claims resulting from unforeseen site conditions, weather impacts, political and lawsuit impacts are a concern and can impact both cost and schedule.	Many of these concerns may be valid and impact the project	Likely	Significant	High		Likely	Negligible	Low		Triangular		Construction	Contract Cost
	ESTIMATE AND SCHEDULE RISKS														
EST-1	Potential Fluctuation in Labor Costs	There is concern that the labor force required for this work could be a challenge, requiring off-site labor, per diem and premium pay, as well as unique markups and multipliers for workers compensation and other factors.	Estimate currently has National Wage rates, which are higher than the local Davis-Bacon Wage Determination. The Estimate also includes $75/day for per diem. There is potential for savings, as the labor wage rate for North Dakota is cheaper than Minnesota. This could impact costs either positively or negatively.	Likely	Significant	High		Very Unlikely	Negligible	Low		Triangular		Cost Engineering	Contract Cost
EST-2	WBS Elements - Estimate confidence	Certain WBS elements are better developed in scope and estimate than other scope areas. Some WBS elements may be more or less conservative. Some elements have greater risk and resulting need for greater contingencies.	The major cost elements for the diversion excavation, hydraulic structures and bridges have been highly developed for feasibility since they make up the bulk of the cost items. Environmental mitigation features are less develop and more conceptual and likely will change. Real Estate may be another area of risk confidence	Likely	Marginal	Moderate		Likely	Negligible	Low		Triangular		Cost Engineering	Contract Cost
EST-3	Estimate assumptions	The estimate assumptions may be flawed in certain cost areas related to scope, crews, productivity, material cost, markups, contingencies, etc. This could result in a flawed budget development.	The estimate has been in development for enough time that scope, crews, productivety, matrerial costs and markups are fairly well developed. Contingencies are from the CSRA	Unlikely	Marginal	Low		Likely	Negligible	Low		Triangular		Cost Engineering	Contract Cost
EST-4	PED & CM	The estiamte currently uses 15% PED and 7% CM of the constrcution cost.	With the high construction cost of this project and the amount of design required for excavation, these percentages may be too high, based on about 16% for the $410M Grand Forks/East Grand Forks Flood project which was more urban levees & floodwalls.	Likely	Significant	High		Unlikely	Negligible	Low		Triangular		Cost Engineering	Project Cost

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Risk Refer No.	Risk Event	Low	Most Likely	High
TL-16	Fuel Cost Concerns	($4,851,910)	$0	$12,129,775

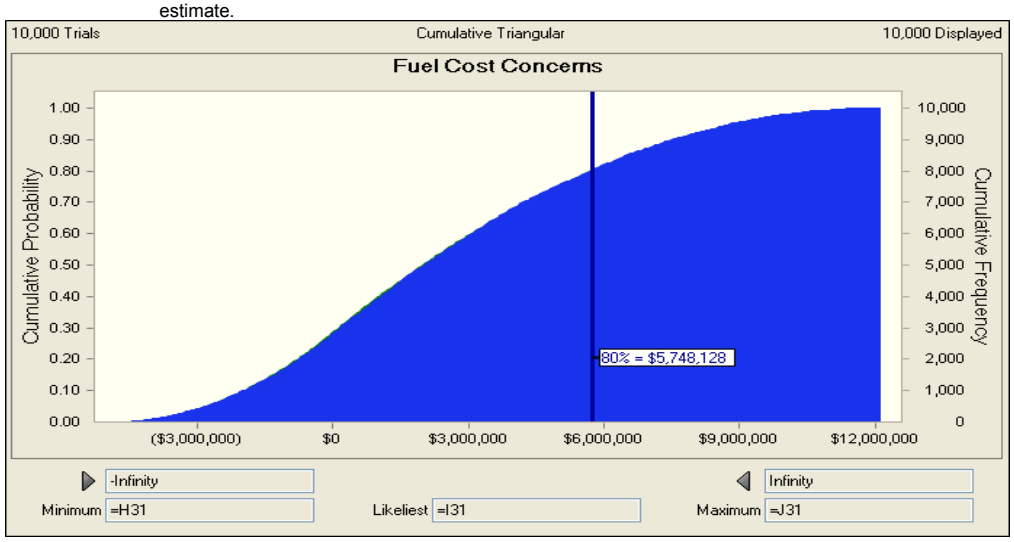
Notes: This item captures the risk that will cause a variance from the current working estimate for the project.

Likely Likely assumes no change from the baseline estimate.

Low Assumes that fuel cost could decrease by 10% from what is currently used in the estimate

High Assume that fuel cost could increase by 25% from the costs currently used in the estimate.

Most Likely	
$48,519,100	Fuel Costs



Assumption: **Fuel Cost Concerns**

Percentile	Assumption values
0%	($4,805,121)
10%	($1,971,961)
20%	($736,105)
30%	$181,128
40%	$1,097,886
50%	$2,027,409
60%	$3,092,071
70%	$4,231,155
80%	$5,748,128
90%	$7,520,320
100%	$11,922,138

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Risk Refer No.	Risk Event	Low	Most Likely	High
LD-1	Mitigation Needs Identified for Upstream Impacts due to staging	($50,000,000)	$0	$0

Notes: This item captures the risk that will cause a variance from the current working estimate for the project.

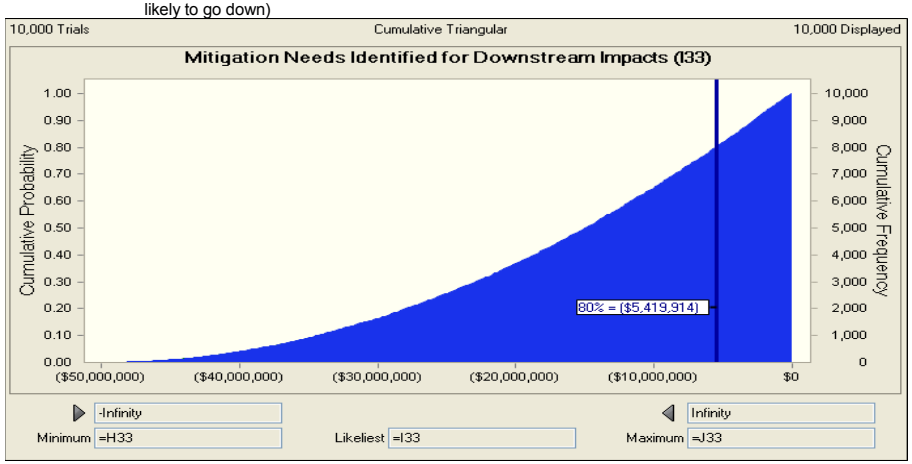
Likely Likely assumes no change from the baseline estimate.

Low There is a possibility that fewer structures may be impacted than is currently estimated based on the type of model used. Assume 200 fewer structures impacted x $250,000 each.

High Assumes that an there are not any additional structures that are affected. (The way the hydraulic model has been set up maximized the area affected so number of structures is likely to go down)

Most Likely

$250,000 Average Structure Cost $250,000 each



Assumption: **Mitigation Needs Identified for Upstream Impacts due to staging**

Percentile	Assumption values
0%	($49,822,175)
10%	($34,305,842)
20%	($27,912,793)
30%	($22,837,028)
40%	($18,627,657)
50%	($14,919,695)
60%	($11,611,177)
70%	($8,423,651)
80%	($5,419,914)
90%	($2,694,460)
100%	($2,724)

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Risk Refer No.	Risk Event	Low	Most Likely	High
LD-2	Potential Savings for Eliminating RR Bridge 4 (RRVW 4th Sub)	($7,709,058)	$0	$0

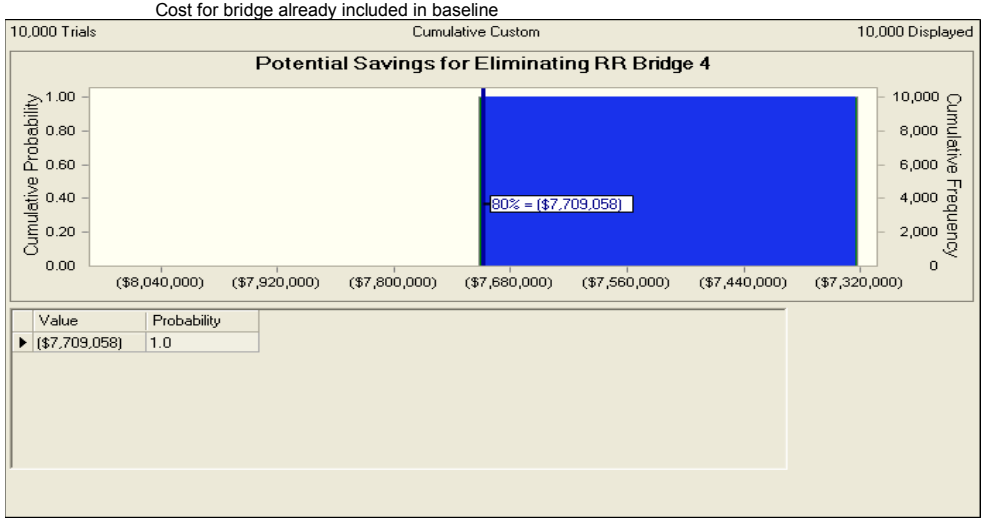
Notes: This item captures the risk that will cause a variance from the current working estimate for the project.

Likely Likely assumes no change from the baseline estimate.

Low If RR abondones RRVW 4th Sub line route this bridge would not be required. Saves cost of bridge + 15% PED and 7% CM

High Cost for bridge already included in baseline

Most Likely	
$6,318,900	RR Bridge 4 + track work



Assumption: **Potential Savings for Eliminating RR Bridge 4 (RRVW 4th Sub)**

Percentile	Assumption values
0%	($7,709,058)
10%	($7,709,058)
20%	($7,709,058)
30%	($7,709,058)
40%	($7,709,058)
50%	($7,709,058)
60%	($7,709,058)
70%	($7,709,058)
80%	($7,709,058)
90%	($7,709,058)
100%	($7,709,058)

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Risk Refer No.	Risk Event	Low	Most Likely	High
LD-4	Appraisal	($10,742,245)	$0	$64,453,470

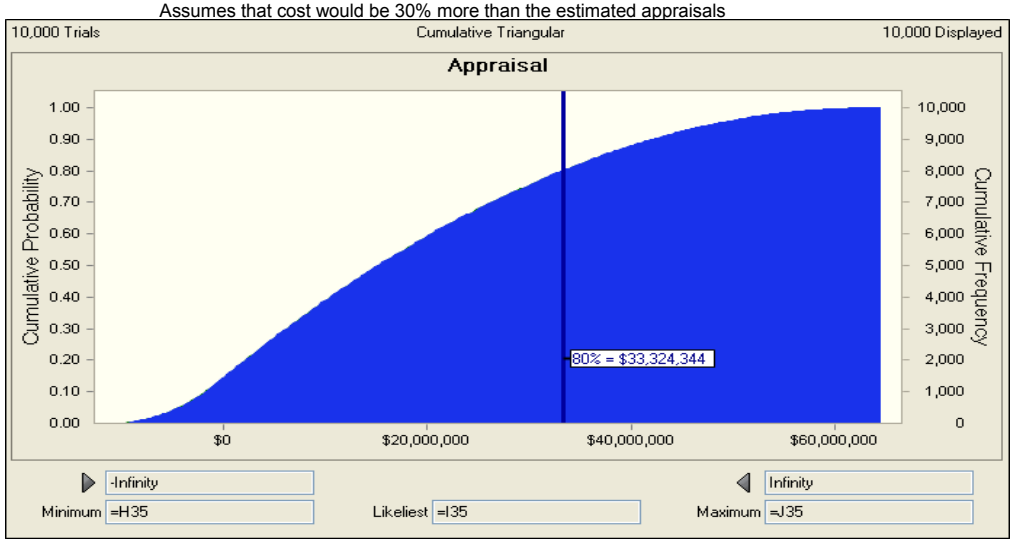
Notes: This item captures the risk that will cause a variance from the current working estimate for the project.

Likely Likely assumes no change from the baseline estimate.

Low Assumes that cost would be 5% less than the estimated aprraisals

High Assumes that cost would be 30% more than the estimated appraisals

Most Likely	
$214,844,900	Lands & Damages



Assumption: Appraisal

Percentile	Assumption values
0%	($10,388,641)
10%	($1,549,940)
20%	$2,305,759
30%	$6,292,704
40%	$10,623,902
50%	$15,268,652
60%	$20,437,725
70%	$26,389,692
80%	$33,324,344
90%	$42,315,936
100%	$63,662,546

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Risk Refer No.	Risk Event	Low	Most Likely	High
LD-5	Non-Appraisal	($39,777,160)	$0	$21,484,490

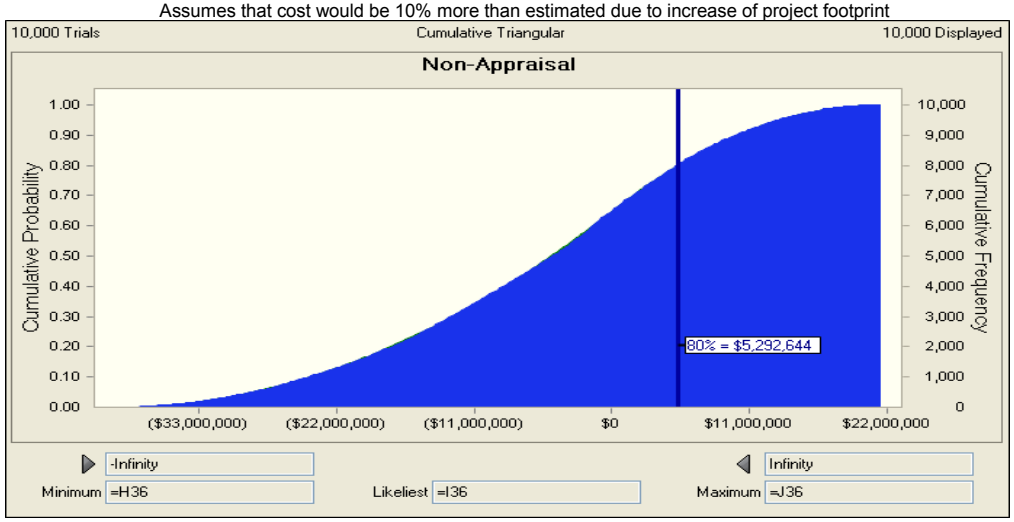
Notes: This item captures the risk that will cause a variance from the current working estimate for the project.

Likely Likely assumes no change from the baseline estimate.

Low Assumes that cost would be 5% less than estimated due to project footprint being less than currently estimated plus $29M recapture cost as identified and estimated by Real Estate Office

High Assumes that cost would be 10% more than estimated due to increase of project footprint

Most Likely	
$214,844,900	Lands & Damages



Assumption: **Non-Appraisal**

Percentile	Assumption values
0%	($39,494,711)
10%	($24,213,339)
20%	($17,494,867)
30%	($12,808,916)
40%	($8,588,155)
50%	($4,659,356)
60%	($1,464,141)
70%	$1,710,913
80%	$5,292,644
90%	$9,929,246
100%	$21,267,254

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Risk Refer No.	Risk Event	Low	Most Likely	High
RE-1	Environmental Mitigation Feature Concerns	$0	$0	$0

Notes: This item captures the risk that will cause a variance from the current working estimate for the project.

Likely Likely assumes no change from the baseline estimate.

Low Assumes Mitigation work to be 20% less than the baseline

High Assumes Mitigation work to be 20% more than the baseline

Most Likely	
$51,120,300	Environmental Mitigation Cost

Assumption: **Environmental Mitigation Feature Concerns**

Percentile	Assumption values
0%	
10%	
20%	
30%	
40%	
50%	
60%	
70%	
80%	
90%	
100%	

MVP - Fargo/Moorhead Feasibility Report (North Dakota Option) - Cost Risk Analysis Model

Risk Refer No.	Risk Event	Low	Most Likely	High
RE-2	Historical Cultural Resource Issues	$0	$0	$0

Notes: This item captures the risk that will cause a variance from the current working estimate for the project.

Likely Likely assumes no change from the baseline estimate = Review and testing + 1 mitigation site per river crossing = $300,000 + (8 x $150,000) = $1,500,000

Low ~~Assumes that no mitigation is required and only cost is the review and testing = $300,000~~ REMOVED FROM MODEL

High ~~Assumes there are two sites per river crossing (one each side of waterway) for mitigation + review & testing = (16 x $150,000) + $300,000 = $2,700,000~~ REMOVED FROM MODEL

Most Likely	
$1,500,000	Cultural baseline estimate

Assumption: Historical Cultural Resource Issues

Percentile	Assumption values
0%	
10%	
20%	
30%	
40%	
50%	
60%	
70%	
80%	
90%	
100%	

MVP - Fargo/Moorhead Feasibility Report (North Dakota Option) - Cost Risk Analysis Model

Risk Refer No.	Risk Event	Low	Most Likely	High
RE-4	Fish Passage Issues	$0	$0	$0

Notes: This item captures the risk that will cause a variance from the current working estimate for the project.

Likely Likely assumes no change from the baseline estimate.

Low Assumes that baseline fish passage design is overdesigned and cost savings of 10% can be achieved

High Assumes that baseline fish passage design required additional design and cost increases by 20%

deleted from model, considered in TL-12

Most Likely	
$5,950,300	RRN Inlet fish passage
$4,550,300	WRR Structure fish passage
$1,826,800	Lower Rush River Structure fish passage
$1,247,200	Rush River Structure fish passage
$1,260,300	RRN Outlet fish passage
$14,834,900	Total

Assumption: **Fish Passage Issues**

Percentile	Assumption values
0%	
10%	
20%	
30%	
40%	
50%	
60%	
70%	
80%	
90%	
100%	

MVP - Fargo/Moorhead Feasibility Report (North Dakota Option) - Cost Risk Analysis Model

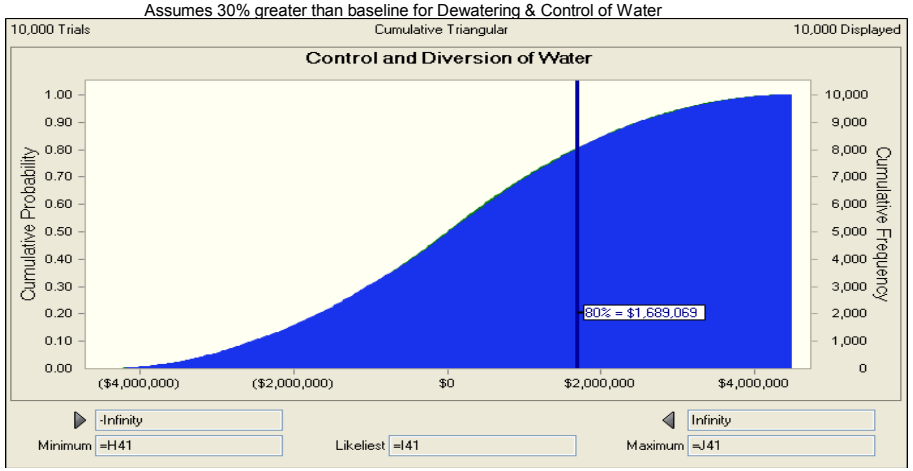
Risk Refer No.	Risk Event	Low	Most Likely	High
CON-2	Control and Diversion of Water	($4,486,110)	$0	$4,486,110

Notes: This item captures the risk that will cause a variance from the current working estimate for the project.

Likely Likely assumes no change from the baseline estimate.

Low Assumes 30% of baseline for Dewatering & Control of Water (Reduced from 50% --> 5% already in TL-6 and 15% already in TL12)

High Assumes 30% greater than baseline for Dewatering & Control of Water



Assumption: Control and Diversion of Water

Percentile	Assumption values
0%	($4,377,189)
10%	($2,530,566)
20%	($1,664,013)
30%	($1,031,560)
40%	($437,215)
50%	$35,804
60%	$525,177
70%	$1,052,176
80%	$1,689,069
90%	$2,500,361
100%	$4,427,802

Most Likely	
$503,800	Reach 1 Dewatering & Control of Water
$145,700	Reach 2 Dewatering & Control of Water
$744,300	Reach 3 Dewatering & Control of Water
$2,656,300	Reach 4 Dewatering & Control of Water
$666,300	Reach 5 Dewatering & Control of Water
$4,102,600	Reach 6 Dewatering & Control of Water
$306,200	Reach 7 Dewatering & Control of Water
$194,300	Reach 8 Dewatering & Control of Water
$1,091,500	RRN Inlet Structure Dewatering
$1,060,800	WRR Structure Dewatering
$1,060,800	Sheyenne River Structure Dewatering
$1,060,800	Maple River Structure Dewatering
$285,000	Lower Rush River Structure Dewatering
$285,000	Rush River Structure Dewatering
$50,400	Wolverton Creek Dewatering
$147,100	Inlet Weir Dewatering
$25,200	Drain 14 Dewatering
$63,500	RRN Inlet Temporary Levees
$114,400	WRR Temporary Levees
$31,800	Inlet Weir Temporary Levees
$200,200	Sheyenne River Structure Temp Levees
$69,300	Maple River Structure Temp Levees
$44,200	Lower Rush River Structure Temp Levees
$44,200	Rush River Structure Temp Levees
$14,953,700	Total

MVP - Fargo/Moorhead Feasibility Report (North Dakota Option) - Cost Risk Analysis Model

Risk Refer No.	Risk Event	Low	Most Likely	High
CON-5	Project Sequencing	($8,700,882)	$0	$43,504,410

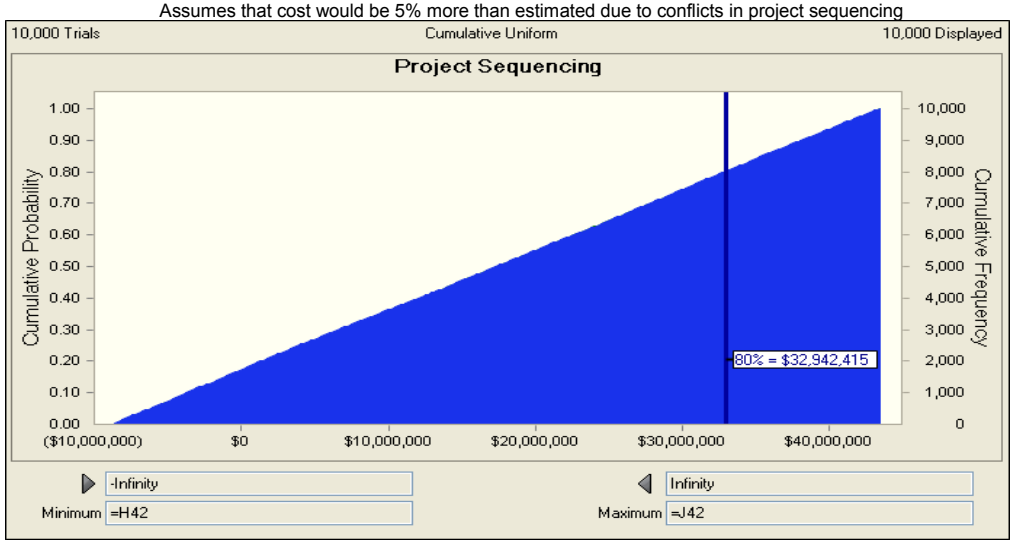
Notes: This item captures the risk that will cause a variance from the current working estimate for the project.

Likely Likely assumes no change from the baseline estimate.

Low Assumes that cost would be 1% less than estimated due to sequencing actually saving money

High Assumes that cost would be 5% more than estimated due to conflicts in project sequencing

Most Likely	
$103,611,800	Roads & Bridges
$46,497,500	Railroad Bridges
$608,789,400	Channels & Canals
$111,189,500	Levees
$870,088,200	



Assumption: **Project Sequencing**

Percentile	Assumption values
0%	($8,697,537)
10%	($3,686,013)
20%	$1,371,805
30%	$6,644,653
40%	$12,095,011
50%	$17,364,637
60%	$22,700,526
70%	$27,845,098
80%	$32,942,415
90%	$38,137,381
100%	$43,497,226

MVP - Fargo/Moorhead Feasibility Report (North Dakota Option) - Cost Risk Analysis Model

Risk Refer No.	Risk Event	Low	Most Likely	High
CON-6	Contract Mods	($24,002,548)	$0	$96,010,190

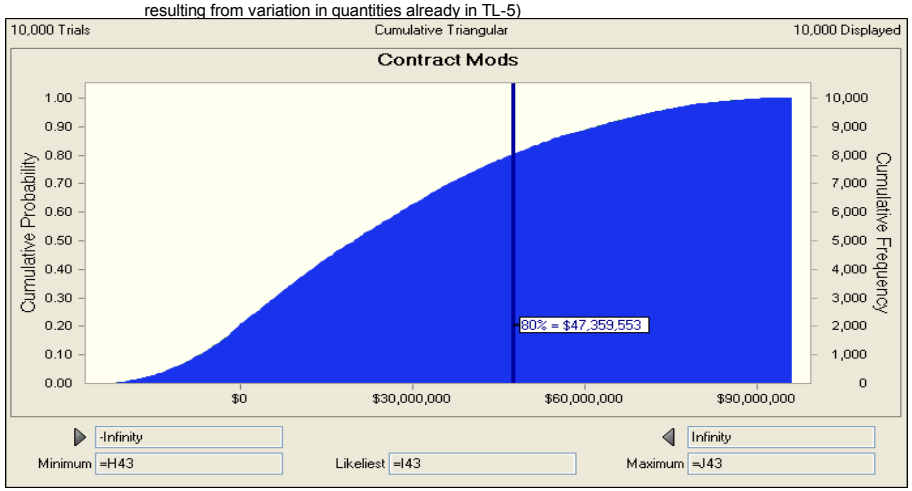
Notes: This item captures the risk that will cause a variance from the current working estimate for the project.

Likely Likely assumes no change from the baseline estimate.

Low Assumes that cost would be 2.5% less than estimated due to contract mods that save money (i.e., by contractor VE proposals)

High Assumes that cost would be 10% more than estimated due to contract mods (mods resulting from variation in quantities already in TL-5)

Most Likely		
$119,479,700	02	Relocations
$51,120,300	06	Fish & Wildlife - Mitigation
$46,497,500	08	Railroads
$608,789,400	09	Channels
$111,190,600	11	Levees, Floodwalls & Floodproofing
$23,024,400	14	Recreational Facilities
$960,101,900		Total



Assumption: **Contract Mods**

Percentile	Assumption values
0%	($23,641,627)
10%	($6,763,507)
20%	($123,118)
30%	$6,190,901
40%	$12,618,928
50%	$20,036,331
60%	$27,912,056
70%	$36,500,594
80%	$47,359,553
90%	$62,372,258
100%	$95,089,397

MVP - Fargo/Moorhead Feasibility Report (North Dakota Option) - Cost Risk Analysis Model

Risk Refer No.	Risk Event	Low	Most Likely	High
EST-1	Potential Fluctuation in Labor Costs	($21,337,805)	$0	$42,675,610

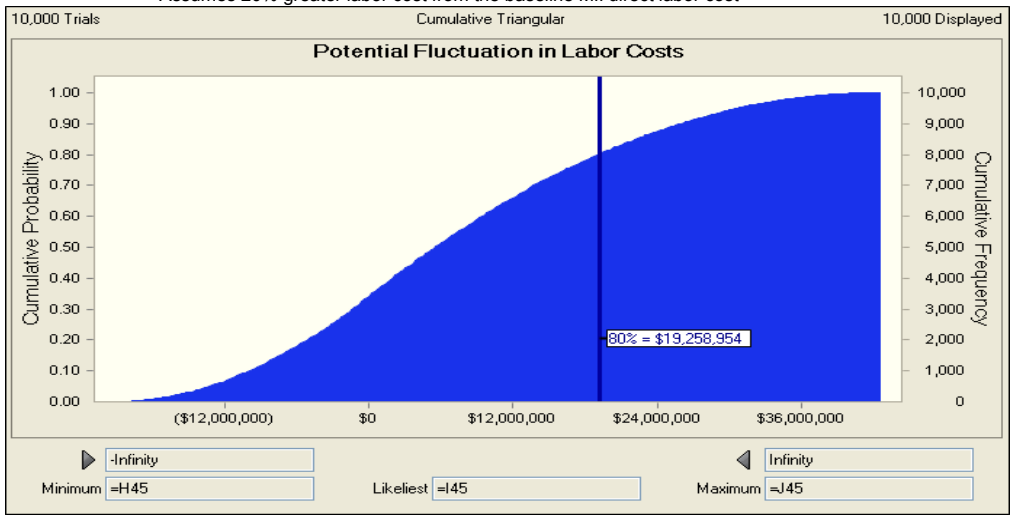
Notes: This item captures the risk that will cause a variance from the current working estimate for the project.

Likely Likely assumes no change from the baseline estimate.

Low Assumes 10% less labor cost from the baseline MII direct labor cost

High Assumes 20% greater labor cost from the baseline MII direct labor cost

Most Likely	
$213,378,052	Labor from MII



Assumption: **Potential Fluctuation in Labor Costs**

Percentile	Assumption values
0%	($21,048,453)
10%	($9,990,599)
20%	($5,155,268)
30%	($1,287,958)
40%	$1,954,277
50%	$5,531,164
60%	$9,458,775
70%	$13,769,589
80%	$19,258,954
90%	$26,023,648
100%	$42,203,668

MVP - Fargo/Moorhead Feasibility Report (North Dakota Option) - Cost Risk Analysis Model

Risk Refer No.	Risk Event	Low	Most Likely	High
EST-2	WBS Elements - Estimate confidence	$0	$0	$0

Notes: This item captures the risk that will cause a variance from the current working estimate for the project.

Likely Likely assumes no change from the baseline estimate.

Low Assumes that cost would be 10% less than estimated for L&D and Mitigation

High Assumes that cost would be 20% more than estimated for L&D and Mitigation

	Most Likely	
	$257,702,600	Lands & Damages
	$51,120,300	Environmental Mitigation
	$308,822,900	

Assumption: WBS Elements - Estimate confidence

Percentile	Assumption values
0%	
10%	
20%	
30%	
40%	
50%	
60%	
70%	
80%	
90%	
100%	

MVP - Fargo/Moorhead Feasibility Report (North Dakota Option) - Cost Risk Analysis Model

Risk Refer No.	Risk Event	Low	Most Likely	High
EST-4	PED & CM	($57,029,940)	$0	$0

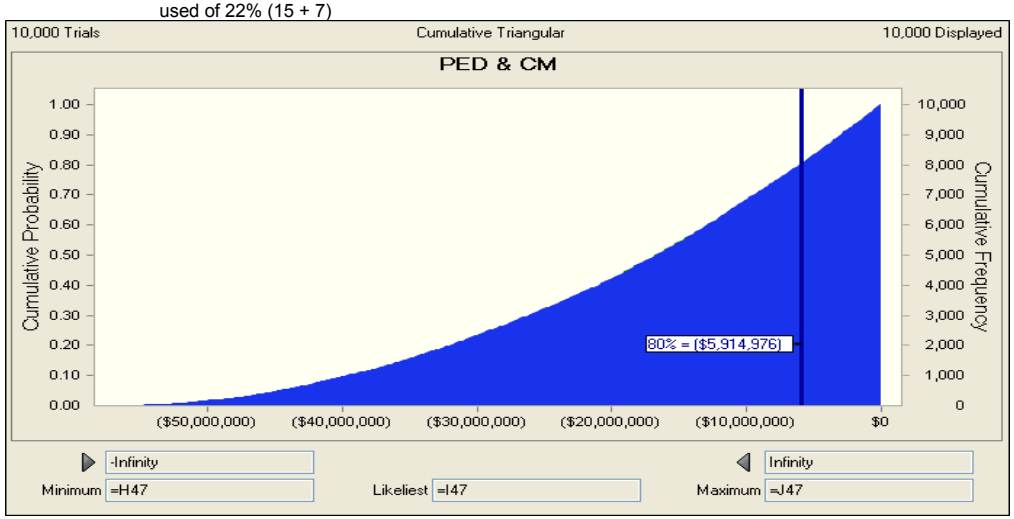
Notes: This item captures the risk that will cause a variance from the current working estimate for the project.

Likely Likely assumes no change from the baseline estimate.

Low Assumes that PED & CM cost would be a total of 16% of the project cost rather than the currently used 22% (15 + 7). The 16% is based on the $410M Grand Forks/East Grand Forks Flood control project which was more urban levees & floodwalls. (16/22 = 0.727)

High Assumes that PED & CM cost would be the percent of the currently estimated construction cost used of 22% (15 + 7)

Most Likely	
$144,015,000	Lands & Damages
$67,207,000	Environmental Mitigation
$211,222,000	



Assumption: PED & CM

Percentile	Assumption values
0%	($56,470,612)
10%	($39,661,854)
20%	($31,915,392)
30%	($26,143,891)
40%	($20,875,317)
50%	($16,574,122)
60%	($12,797,376)
70%	($9,350,377)
80%	($5,914,976)
90%	($2,900,895)
100%	($9,808)

MVP - Fargo/Moorhead Feasibility Report (North Dakota Option) - Cost Risk Analysis Model

Risk Refer No.	Risk Event	Low	Most Likely	High
PR-1	Uncertainty with Funding Stream	$0	$0	$0

Notes: This item captures the risk that will cause a variance from the current working estimate for the project.

Likely Likely assumes no change from the baseline estimate.

Low Assumes 10% less than baseline project cost estimate

High Assumes 20% more than baseline project cost estimate

Most Likely	
$214,844,900	01 Lands & Damages
$119,479,700	02 Relocations
$51,120,300	06 Environmental Mitigation
$46,497,500	08 RR Bridges
$608,789,400	09 Diversion Channel
$111,190,600	11 Levees & Floodwalls
$23,024,400	14 Recreational Features
$144,015,000	30 PED
$67,207,000	31 CM
$1,386,168,800	Total

Assumption: **Uncertainty with Funding Stream**

Percentile	Assumption values
0%	
10%	
20%	
30%	
40%	
50%	
60%	
70%	
80%	
90%	
100%	

MVP - Fargo/Moorhead Feasibility Report (North Dakota Option) - Cost Risk Analysis Model

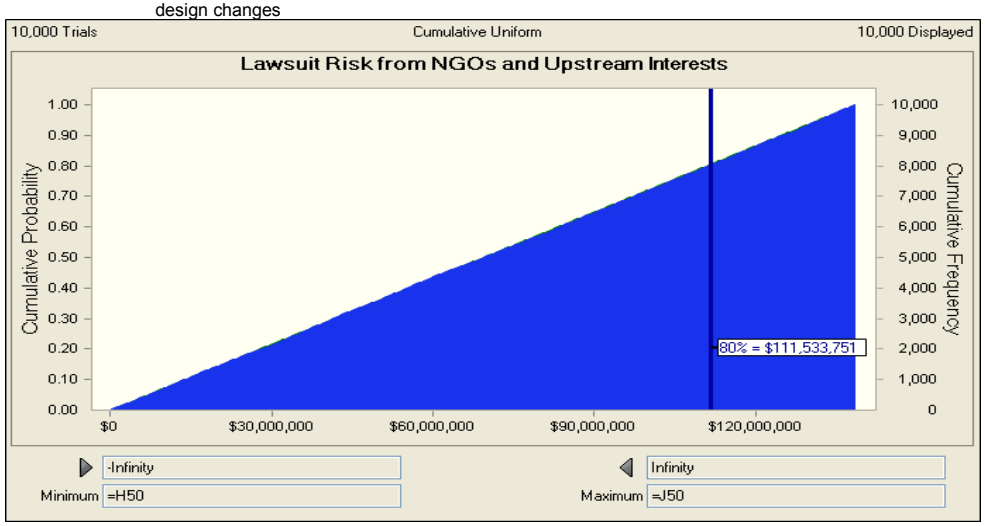
Risk Refer No.	Risk Event	Low	Most Likely	High
PR-6	Lawsuit Risk from NGOs and Upstream Interests	$0	$0	$138,616,880

Notes: This item captures the risk that will cause a variance from the current working estimate for the project.

Likely Likely assumes no change from the baseline estimate.

Low Assumes cost to remain at baseline if there are no lawsuits from upstream interest

High Assumes 10% greater cost due to lawsuits from upstream interests that cause project delays or design changes



Assumption: **Lawsuit Risk from NGOs and Upstream Interests**

Percentile	Assumption values
0%	$19,731
10%	$13,897,349
20%	$28,195,987
30%	$41,695,174
40%	$55,147,314
50%	$69,567,899
60%	$83,788,954
70%	$97,483,674
80%	$111,533,751
90%	$125,336,460
100%	$138,614,006

Most Likely	
$214,844,900	01 Lands & Damages
$119,479,700	02 Relocations
$51,120,300	06 Environmental Mitigation
$46,497,500	08 RR Bridges
$608,789,400	09 Diversion Channel
$111,190,600	11 Levees & Floodwalls
$23,024,400	14 Recreational Features
$144,015,000	30 PED
$67,207,000	31 CM
$1,386,168,800	Total

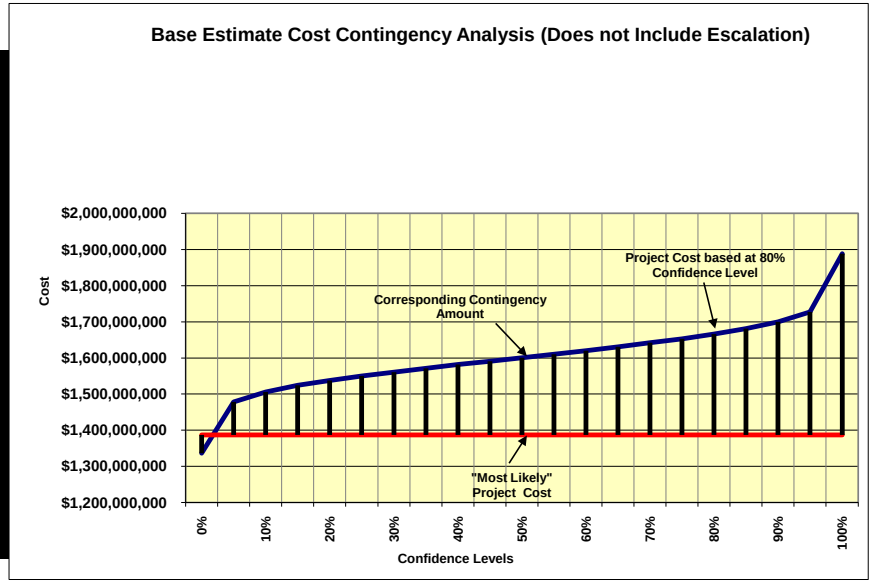
MVP - Fargo/Moorhead Feasibility Report (LPP - North Dakota Option) - PDT Risk Register

Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions	Project Cost				Project Schedule				Variance Distribution	Correlation to Other(s)	Responsibility/POC	Affected Project Component
				Likelihood*	Impact*	Risk Level*	Rough Order Impact ($)	Likelihood*	Impact*	Risk Level*	Rough Order Impact (mo)				
Contract Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)															
	PROJECT & PROGRAM MGMT														
PPM-1	Project Schedule in Question	Due to the size and magnitude of the project, as well as the complexity of the structures and sequencing, there is inherent concern regarding the actual project schedule.	This could cause a variance in the project schedule (positive or negative, but most likely negative).	Likely	Significant	High		Likely	Marginal	Moderate		Uniform		Project Manager	Project Cost & Schedule
PPM-2	Accelerated Design Schedule	An accelerated schedule can result in inadequate studies, shortcuts in plans, change in contract acquisition strategy, failure to capture full scope, miss-steps, etc. There is the potential of moving forward with limited information.	The issue is covered in other risk events.	Likely	Significant	High		Likely	Significant	High		Triangular		District Management	Project Cost & Schedule
PPM-3	Unplanned Work that Must be Accommodated	Due to the preliminary stage of project development, there is potential that there may be features or subfeatures of work that must be added to construction. Ice handling and sediment transport are the two most likely issues that must be accommodated. There may also be mitigation requirements.	Most of these subfeatures are already captured in the design and estimate, but the configuration may change.	Likely	Significant	High		Likely	Marginal	Moderate		Yes-No		Project Manager	Project Cost & Schedule
PPM-4	Local Agency/Regulator Issues	The acceleration of the planning schedule has forced reviews and collaboration without much time given to local agencies and regulators. Although there has been communication between the Government and the local agencies, these agencies have not responded with definitive decisions. This could present potential impacts.	There has been some discussion and pushback from agencies to entertain altering the level of flows allowed in the protected area from a 2-year as designed to a 5-year.Specifically, agencies may require that lower flows must be accommodated. This could impact cost and schedule.	Likely	Significant	High		Likely	Marginal	Moderate		Yes-No		Project Manager	Project Cost & Schedule
PPM-7	Contracting Staffing	Contracting is experiencing a lack of staffing, causing challenges in obtaining resources on a timely basis for all procurements.	Could cause a variance in the schedule.	Unlikely	Marginal	Low		Unlikely	Marginal	Low		Uniform		District Management	Project Schedule
PPM-8	Scope Changes	The many competing interests & priorities, coupled with an accelerated schedule could result in scope changes currently uncaptured or unanticipated. These scope changes would require additional coordination, cause further design and investigation and potentially impact the real estate acquisitions.	While minor alterations to the final alignment may occur, there should not be any major changes.	Likely	Marginal	Moderate		Likely	Significant	High		Yes-No		Project Manager	Project Cost & Schedule
	CONTRACT ACQUISITION RISKS														
CA-1	Undefined Acquisition Strategy	The overall acquisition strategy for both design and construction has not been defined. Acquisition strategy could affect/impact bid competition and bid costs. It can also move risk onto the Government, causing need for greater contingencies. Clarification should be made related to number of contracts, contract types, etc. authority for this procurement.	Acquisition stratagy needs to be defined and could impact the cost and schedule.	Likely	Marginal	Moderate		Unlikely	Marginal	Low		Triangular		TASB	Contract Cost & Project Schedule
CA-2	Preference to Small Business	Most of the larger requirements are so large that they would not be suitable for small business. However, there is potential for some of the restoration, seeding, and mitigation may be suitable for small business. There is a requirement for review by the PARC if the requirements were less than $50 Million.	The project is so large, it is likely that even separable requirements would not be suitable for small business. Could impact cost and schedule.	Unlikely	Marginal	Low		Unlikely	Marginal	Low		Triangular		Contracting	Contract Cost & Project Schedule
CA-3	Numerous Separate Contracts	There is potential to have numerous separate contracts, especially if the continuing contracts authority is not granted. Funding stream issues could also have an impact on the number of contracts.	The best case would be 8 contracts. The worst case would be in excess of 12 contracts. More contracts could increase bidding competition. This could have a significant effect on cost and schedule (either positive or negative).	Very Likely	Significant	High		Unlikely	Marginal	Low		Triangular		Contracting	Contract Cost
CA-4	Potential Bid Protests	The larger size of the project increase contractor interests in bidding, but also increases potntial risk for protets due to hungry economy and interest in obtaining project dollars.	This could impact cost and schedule.	Likely	Marginal	Moderate		Likely	Marginal	Moderate		Yes-No		Contracting	Contract Cost
	TECHNICAL RISKS														
TL-1	Uncertainty with Geotechnical Conditions	There is uncertainty with geotechnical conditions but the Phase 3 estimate uses recent borings from 2010 to help define the the soil parameters for excavation and how that will impact the construction productivity. The material is all clay and silt.	The current working estimate is fairly conservative. However, variation in the ultimate characterization of material could cause significant variance in productivity. Could impact cost and schedule (positive or negative).	Likely	Critical	High		Likely	Marginal	Moderate		Triangular		Geotechnical/Civil Design	Contract Cost & Project Schedule

- BASE CONTINGENCY DEVELOPMENT -

Contingency Analysis

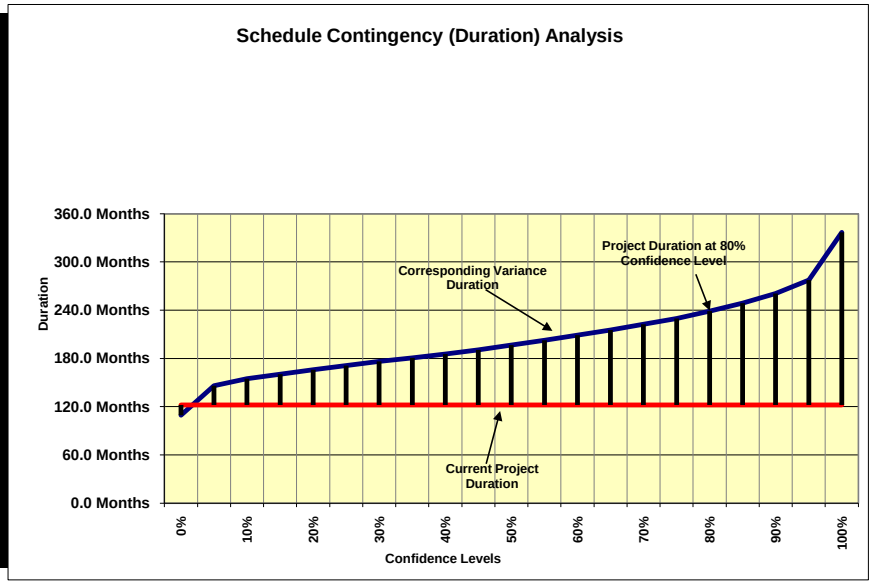
Most Likely Cost Estimate	$1,387,078,819		
Confidence Level	**Project Cost**	**Contingency**	**Contingency %**
0%	$1,336,855,935	($50,222,884)	-3.62%
5%	$1,478,536,519	$91,457,700	6.59%
10%	$1,505,453,347	$118,374,528	8.53%
15%	$1,524,147,605	$137,068,786	9.88%
20%	$1,537,481,951	$150,403,131	10.84%
25%	$1,549,681,209	$162,602,390	11.72%
30%	$1,560,624,812	$173,545,992	12.51%
35%	$1,571,117,586	$184,038,767	13.27%
40%	$1,581,539,408	$194,460,589	14.02%
45%	$1,590,558,739	$203,479,920	14.67%
50%	$1,600,501,068	$213,422,249	15.39%
55%	$1,610,094,229	$223,015,410	16.08%
60%	$1,620,246,516	$233,167,697	16.81%
65%	$1,630,424,107	$243,345,287	17.54%
70%	$1,641,958,964	$254,880,145	18.38%
75%	$1,653,035,337	$265,956,518	19.17%
80%	**$1,666,015,833**	**$278,937,013**	**20.11%**
85%	$1,681,112,745	$294,033,926	21.20%
90%	$1,699,645,557	$312,566,738	22.53%
95%	$1,727,019,327	$339,940,507	24.51%
100%	$1,888,078,395	$500,999,575	36.12%



- SCHEDULE CONTINGENCY (DURATION) DEVELOPMENT -

Contingency Analysis

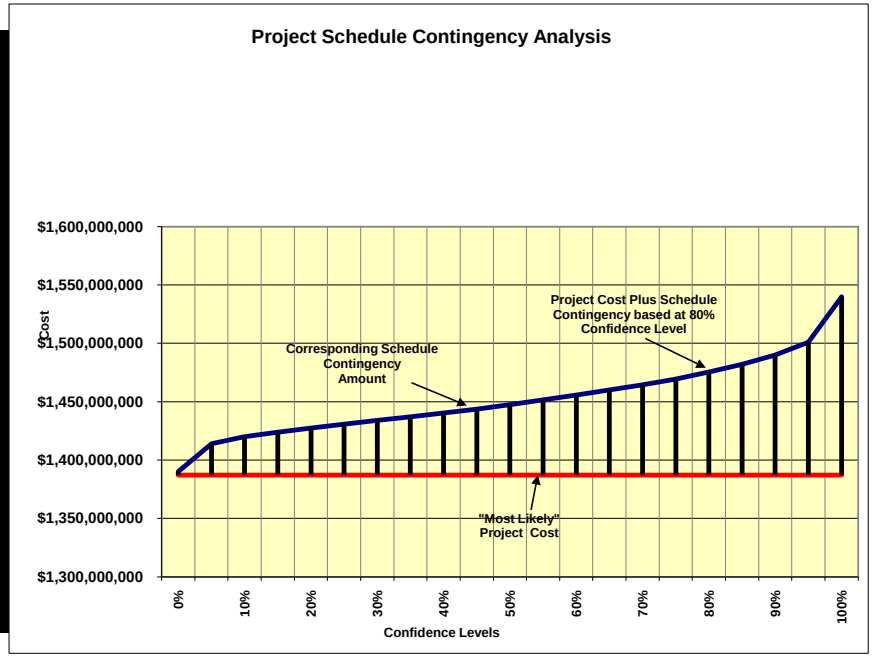
Most Likely Schedule	122.2 Months		
Confidence Level	**Project Duration**	**Contingency**	**Contingency %**
0%	109.6 Months	-12.6 Months	-10.29%
5%	145.9 Months	23.7 Months	19.44%
10%	154.8 Months	32.6 Months	26.68%
15%	160.6 Months	38.4 Months	31.45%
20%	166.1 Months	44.0 Months	35.99%
25%	171.1 Months	48.9 Months	40.05%
30%	176.2 Months	54.0 Months	44.21%
35%	180.8 Months	58.6 Months	47.98%
40%	185.6 Months	63.4 Months	51.90%
45%	190.7 Months	68.6 Months	56.14%
50%	196.5 Months	74.3 Months	60.85%
55%	202.8 Months	80.6 Months	65.98%
60%	208.9 Months	86.8 Months	71.03%
65%	215.4 Months	93.3 Months	76.34%
70%	222.4 Months	100.2 Months	82.04%
75%	229.9 Months	107.7 Months	88.17%
80%	**238.7 Months**	**116.6 Months**	**95.43%**
85%	248.7 Months	126.6 Months	103.63%
90%	260.7 Months	138.5 Months	113.42%
95%	277.6 Months	155.4 Months	127.23%
100%	336.6 Months	214.5 Months	175.56%

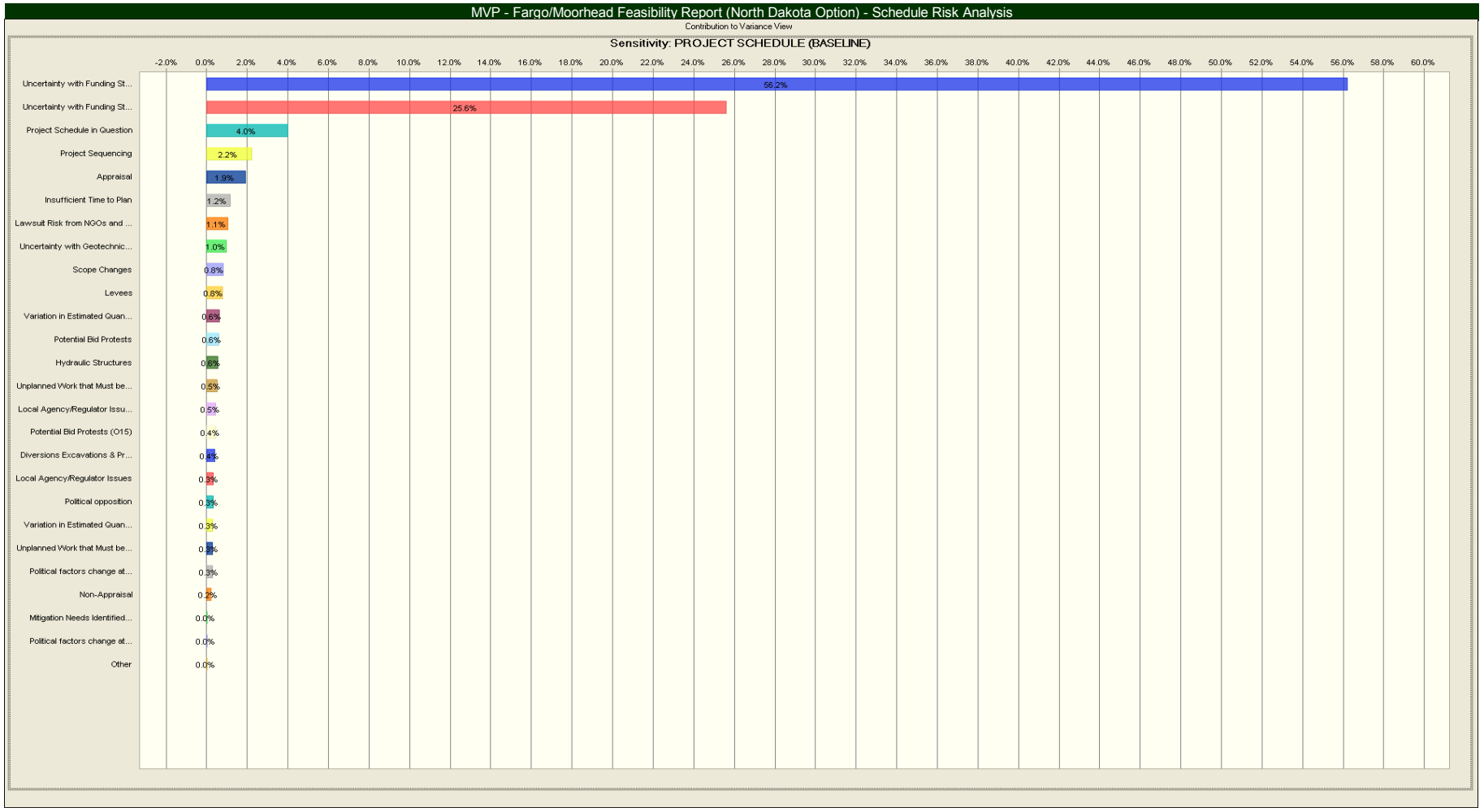


- SCHEDULE CONTINGENCY (AMOUNT) DEVELOPMENT -

Contingency Analysis

Most Likely Cost Estimate	$1,387,078,819		
Confidence Level	**Project Cost**	**Contingency**	**Contingency %**
0%	$1,390,078,560	$2,999,741	0.22%
5%	$1,414,056,107	$26,977,288	1.94%
10%	$1,419,895,416	$32,816,596	2.37%
15%	$1,423,742,019	$36,663,200	2.64%
20%	$1,427,399,336	$40,320,517	2.91%
25%	$1,430,676,248	$43,597,428	3.14%
30%	$1,434,034,448	$46,955,629	3.39%
35%	$1,437,072,372	$49,993,552	3.60%
40%	$1,440,234,194	$53,155,375	3.83%
45%	$1,443,649,857	$56,571,038	4.08%
50%	$1,447,448,730	$60,369,911	4.35%
55%	$1,451,589,167	$64,510,348	4.65%
60%	$1,455,658,735	$68,579,915	4.94%
65%	$1,459,944,487	$72,865,667	5.25%
70%	$1,464,541,463	$77,462,644	5.58%
75%	$1,469,484,212	$82,405,392	5.94%
80%	**$1,475,338,873**	**$88,260,054**	**6.36%**
85%	$1,481,954,325	$94,875,505	6.84%
90%	$1,489,848,881	$102,770,062	7.41%
95%	$1,500,991,501	$113,912,681	8.21%
100%	$1,539,971,135	$152,892,316	11.02%

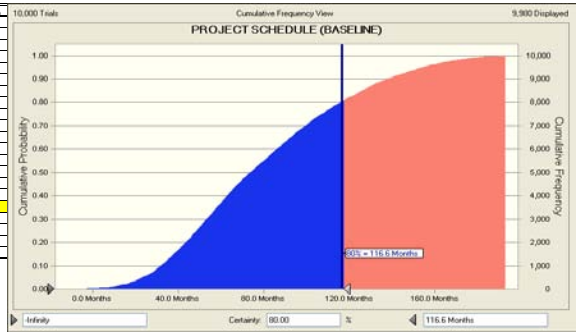


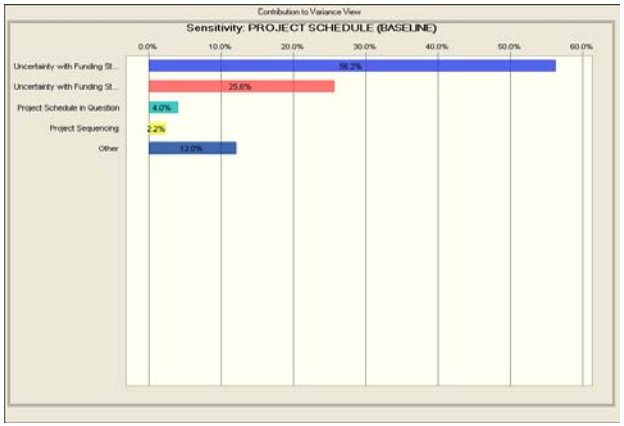

MVP - Fargo/Moorhead Feasibility Report (North Dakota Option) - Schedule Risk Analysis
Contribution to Variance View
Sensitivity: PROJECT SCHEDULE (BASELINE)
-2.0% 0.0% 2.0% 4.0% 6.0% 8.0% 10.0% 12.0% 14.0% 16.0% 18.0% 20.0% 22.0% 24.0% 26.0% 28.0% 30.0% 32.0% 34.0% 36.0% 38.0% 40.0% 42.0% 44.0% 46.0% 48.0% 50.0% 52.0% 54.0% 56.0% 58.0% 60.0%
Uncertainty with Funding St... 56.2%
Uncertainty with Funding St... 25.6%
Project Schedule in Question 4.0%
Project Sequencing 2.2%
Appraisal 1.9%
Insufficient Time to Plan 1.2%
Lawsuit Risk from NGOs and ... 1.1%
Uncertainty with Geotechnic... 1.0%
Scope Changes 0.8%
Levees 0.8%
Variation in Estimated Quan... 0.6%
Potential Bid Protests 0.6%
Hydraulic Structures 0.6%
Unplanned Work that Must be... 0.5%
Local Agency/Regulator Issu... 0.5%
Potential Bid Protests (O15) 0.4%
Diversions Excavations & Pr... 0.4%
Local Agency/Regulator Issues 0.3%
Political opposition 0.3%
Variation in Estimated Quan... 0.3%
Unplanned Work that Must be... 0.2%
Political factors change at... 0.2%
Non-Appraisal 0.2%
Mitigation Needs Identified... 0.0%
Political factors change at... 0.0%
Other 0.0%

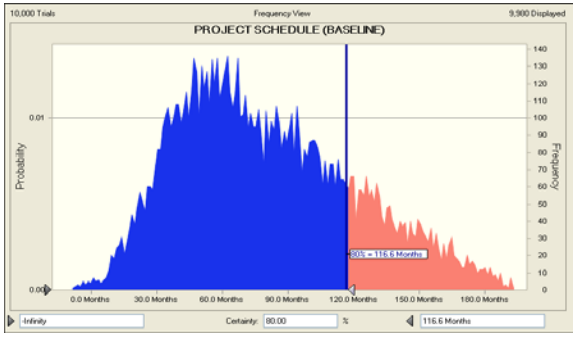
MVP - Fargo/Moorhead Feasibility Report (North Dakota Option) - Schedule Risk Analysis Model

Risk No.	Risk/Opportunity Event	Project Schedule			Variance Distribution	Correlation to Other(s)	Crystal Ball Simulation Expected Values (mos.)				Crystal Ball Simulation Expected Values (%s)			
		Likelihood*	Impact*	Risk Level*			Low	Most Likely	High		Low	Most Likely	High	Percentages are calculated as the variance from the assumption value to facilitate iteration of the model should the cost values change throughout the project phases. Uniform distribution percentages reflect variation from the total project cost.
Internal Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)														
PROJECT & PROGRAM MGMT														
PPM-1	Project Schedule in Question	Likely	Marginal	Moderate	Uniform		-12.0 Months	0.0 Months	12.0 Months		-9.82%	0.00%	9.82%	100%
PPM-2	Insufficient Time to Plan	Likely	Significant	High	Triangular	PPM-3	-6.0 Months	0.0 Months	12.0 Months		-4.91%	0.00%	9.82%	100%
PPM-3	Unplanned Work that Must be Accommodated	Likely	Marginal	Moderate	Yes-No/Uniform	PPM-2	0.0 Months	0.0 Months	12.0 Months		0.00%	0.00%	9.82%	65%
PPM-4	Local Agency/Regulator Issues	Likely	Marginal	Moderate	Yes-No/Uniform		0.0 Months	0.0 Months	9.0 Months		0.00%	0.00%	7.37%	65%
PPM-8	Scope Changes	Likely	Significant	High	Triangular		-6.0 Months	0.0 Months	12.0 Months		-4.91%	0.00%	9.82%	100%
CONTRACT ACQUISITION RISKS														
CA-4	Potential Bid Protests	Likely	Marginal	Moderate	Yes-No/Uniform		0.0 Months	0.0 Months	12.0 Months		0.00%	0.00%	9.82%	65%
TECHNICAL RISKS														
TL-1	Uncertainty with Geotechnical Conditions	Likely	Marginal	Moderate	Triangular		-6.0 Months	0.0 Months	12.0 Months		-4.91%	0.00%	9.82%	100%
TL-5	Variation in Estimated Quantities	Likely	Marginal	Moderate	Yes-No/Uniform		-6.0 Months	0.0 Months	12.0 Months		-4.91%	0.00%	9.82%	65%
TL-11	Diversions Excavations & Productivity	Likely	Marginal	Moderate	Triangular		-6.0 Months	0.0 Months	6.0 Months		-4.91%	0.00%	4.91%	100%
TL-12	Hydraulic Structures	Likely	Marginal	Moderate	Triangular		0.0 Months	0.0 Months	12.0 Months		0.00%	0.00%	9.82%	100%
TL-13	Levees	Likely	Marginal	Moderate	Triangular		-12.0 Months	0.0 Months	6.0 Months		-9.82%	0.00%	4.91%	100%
LANDS AND DAMAGES RISKS														
LD-1	Mitigation Needs Identified for Upstream Impacts due to staging	Likely	Significant	High	Yes-No/Triangular		0.0 Months	0.0 Months	6.0 Months		0.00%	0.00%	4.91%	65%
LD-4	Appraisal	Likely	Marginal	Moderate	Triangular		-12.0 Months	0.0 Months	12.0 Months		-9.82%	0.00%	9.82%	100%
LD-5	Non-Appraisal	Likely	Marginal	Moderate	Triangular		0.0 Months	0.0 Months	6.0 Months		0.00%	0.00%	4.91%	100%
CONSTRUCTION RISKS														
CON-5	Project Sequencing	Likely	Marginal	Moderate	Uniform		-6.0 Months	0.0 Months	12.0 Months		-4.91%	0.00%	9.82%	100%
Programmatic Risks (External Risk Items are those that are generated, caused, or controlled exclusively outside the PDT's sphere of influence.)														
PR-1	Uncertainty with Funding Stream	Very Likely	Significant	High	Yes-No/Triangular		0.0 Months	0.0 Months	150.0 Months		0.00%	0.00%	122.79%	85%
PR-4	Political factors change at state, local, or federal level	Unlikely	Crisis	High	Yes-No/Uniform	PR-1	0.0 Months	0.0 Months	12.0 Months		0.00%	0.00%	9.82%	25%
PR-5	Political opposition	Likely	Marginal	Moderate	Uniform		0.0 Months	0.0 Months	6.0 Months		0.00%	0.00%	4.91%	100%
PR-6	Lawsuit Risk from NGOs and Downstream Interests	Unlikely	Significant	Moderate	Uniform		0.0 Months	0.0 Months	12.0 Months		0.00%	0.00%	9.82%	100%
								0.0 Months		*Not Part of Study - Placeholder for Project Summation Purposes Only*				

	Percentile	Baseline Schedule Duration	Contingency	Baseline w/ Contingency	Contingency %
PROJECT SCHEDULE (BASELINE)	0%	122.2 Months	-12.6 Months	109.6 Months	-10.29%
	5%	122.2 Months	23.7 Months	145.9 Months	19.44%
	10%	122.2 Months	32.6 Months	154.8 Months	26.68%
	15%	122.2 Months	38.4 Months	160.6 Months	31.45%
	20%	122.2 Months	44.0 Months	166.1 Months	35.99%
	25%	122.2 Months	48.9 Months	171.1 Months	40.05%
	30%	122.2 Months	54.0 Months	176.2 Months	44.21%
	35%	122.2 Months	58.6 Months	180.8 Months	47.98%
	40%	122.2 Months	63.4 Months	185.6 Months	51.90%
	45%	122.2 Months	68.6 Months	190.7 Months	56.14%
	50%	122.2 Months	74.3 Months	196.5 Months	60.85%
	55%	122.2 Months	80.6 Months	202.8 Months	65.98%
	60%	122.2 Months	86.8 Months	208.9 Months	71.03%
	65%	122.2 Months	93.3 Months	215.4 Months	76.34%
	70%	122.2 Months	100.2 Months	222.4 Months	82.04%
	75%	122.2 Months	107.7 Months	229.9 Months	88.17%
	80%	122.2 Months	116.6 Months	238.7 Months	95.43%
	85%	122.2 Months	126.6 Months	248.7 Months	103.63%
	90%	122.2 Months	138.5 Months	260.7 Months	113.42%
	95%	122.2 Months	155.4 Months	277.6 Months	127.23%
	100%	122.2 Months	214.5 Months	336.6 Months	175.56%







MVP - Fargo/Moorhead Feasibility Report (North Dakota Option) - Schedule Risk Analysis Model	
Estimated Total Project Cost (Price Level)	$1,387,078,819
Max. Anticipated Annual Amount	$136,337,605
Enter Current OMB Escalation Rate	1.80%
Enter Current Project Location Escalation Rate	1.88%
Enter Assumed Hotel Rate	5.00%

	Date	Escalation Delta Amount	Hotel Amount	Total Schedule Contingency
Enter Current Project Start	29-Jan-10			
Enter Baseline Project Completion	2-Apr-20	$11,297,281.96		$11,297,281.96
Project Completion at 0% Confidence	16-Mar-19	$10,134,997.51	($7,135,256.72)	$2,999,740.78
Project Completion at 5% Confidence	25-Mar-22	$13,493,670.85	$13,483,617.21	$26,977,288.05
Project Completion at 10% Confidence	19-Dec-22	$14,311,616.44	$18,504,979.94	$32,816,596.38
Project Completion at 15% Confidence	14-Jun-23	$14,850,432.34	$21,812,767.28	$36,663,199.62
Project Completion at 20% Confidence	30-Nov-23	$15,362,733.91	$24,957,783.31	$40,320,517.23
Project Completion at 25% Confidence	29-Apr-24	$15,821,749.76	$27,775,678.63	$43,597,428.39
Project Completion at 30% Confidence	30-Sep-24	$16,292,152.23	$30,663,476.35	$46,955,628.58
Project Completion at 35% Confidence	17-Feb-25	$16,717,691.72	$33,275,860.55	$49,993,552.27
Project Completion at 40% Confidence	13-Jul-25	$17,160,586.42	$35,994,788.26	$53,155,374.68
Project Completion at 45% Confidence	17-Dec-25	$17,639,038.10	$38,932,000.04	$56,571,038.14
Project Completion at 50% Confidence	11-Jun-26	$18,171,168.13	$42,198,742.85	$60,369,910.98
Project Completion at 55% Confidence	18-Dec-26	$18,751,143.00	$45,759,204.82	$64,510,347.82
Project Completion at 60% Confidence	24-Jun-27	$19,321,190.80	$49,258,724.58	$68,579,915.38
Project Completion at 65% Confidence	7-Jan-28	$19,921,520.81	$52,944,146.64	$72,865,667.46
Project Completion at 70% Confidence	6-Aug-28	$20,565,445.81	$56,897,198.04	$77,462,643.85
Project Completion at 75% Confidence	22-Mar-29	$21,257,805.09	$61,147,587.21	$82,405,392.30
Project Completion at 80% Confidence	17-Dec-29	$22,077,901.33	$66,182,152.71	$88,260,054.04
Project Completion at 85% Confidence	17-Oct-30	$23,004,565.76	$71,870,939.68	$94,875,505.45
Project Completion at 90% Confidence	16-Oct-31	$24,110,401.80	$78,659,659.99	$102,770,061.80
Project Completion at 95% Confidence	12-Mar-33	$25,671,212.80	$88,241,468.59	$113,912,681.38
Project Completion at 100% Confidence	10-Feb-38	$31,131,315.02	$121,761,000.86	$152,892,315.87

Entry Required
Do Not Overwrite
Summary Data -- Do Not Overwrite

MVP - Fargo/Moorhead Feasibility Report (North Dakota Option) - Schedule Risk Analysis Model

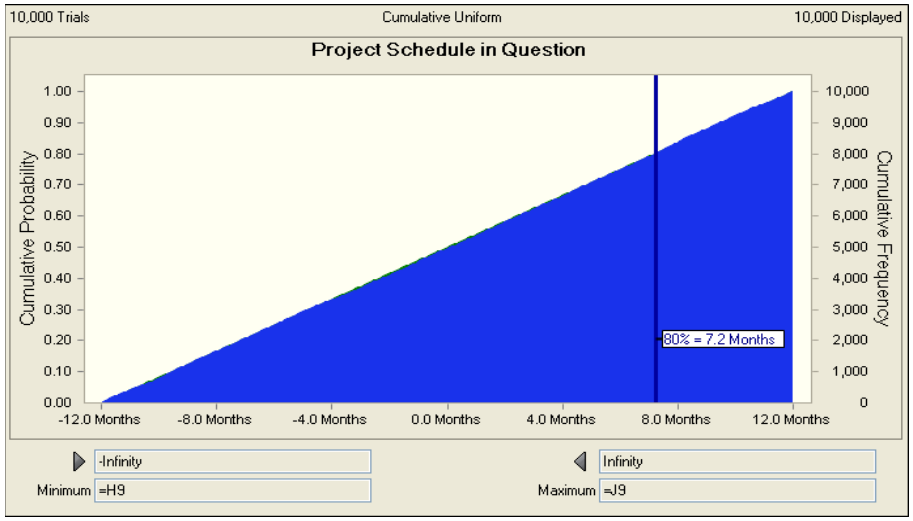
Risk Refer No.	Risk Event	Low	Most Likely	High
PPM-1	Project Schedule in Question	-12.0 Months	0.0 Months	12.0 Months

Notes: This item captures the risk that will cause a variance from the baseline schedule for the project.

Likely Likely assumes no change from the baseline schedule.

Low Assumes schedule concerns are conservative and actual project schedule can be exceeded

High Assumes project schedule is delayed due to complexity of structures and sequencing



Assumption: **Project Schedule in Question**

Percentile	Assumption values
0%	'-12.0 Months
10%	'-9.5 Months
20%	'-7.1 Months
30%	'-4.8 Months
40%	'-2.2 Months
50%	0.1 Months
60%	2.5 Months
70%	4.8 Months
80%	7.2 Months
90%	9.5 Months
100%	12.0 Months

MVP - Fargo/Moorhead Feasibility Report (North Dakota Option) - Schedule Risk Analysis Model

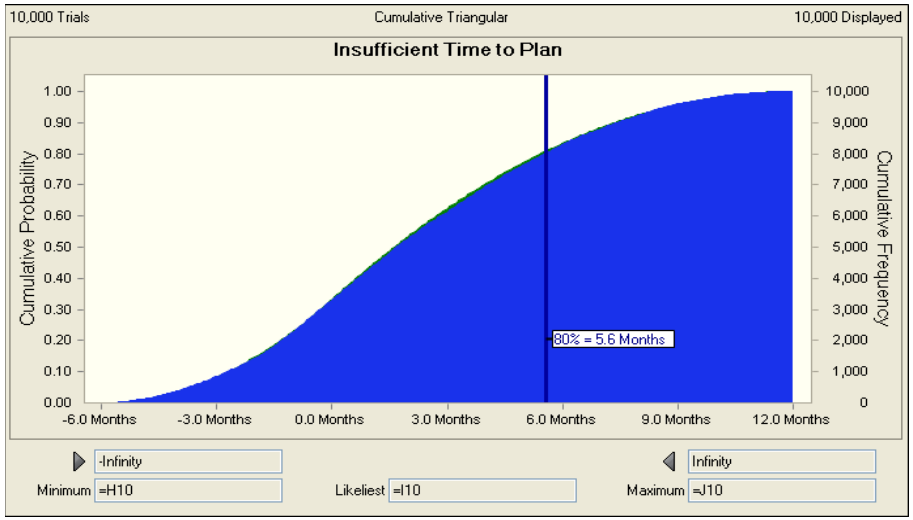
Risk Refer No.	Risk Event	Low	Most Likely	High
PPM-2	Accelerated Design Schedule	-6.0 Months	0.0 Months	12.0 Months

Notes: This item captures the risk that will cause a variance from the baseline schedule for the project.

Likely Likely assumes no change from the baseline schedule.

Low Assumes that best case diversion structure design allow construction to advance by 6 months

High Assumes that uncertainty with the diversion structure design and/or model results causes a 12 month delay in construction



Assumption: **Accelerated Design Schedule**

Percentile	Assumption values
0%	'-6.0 Months
10%	'-2.7 Months
20%	'-1.3 Months
30%	'-0.3 Months
40%	0.7 Months
50%	1.7 Months
60%	2.8 Months
70%	4.1 Months
80%	5.6 Months
90%	7.4 Months
100%	11.9 Months

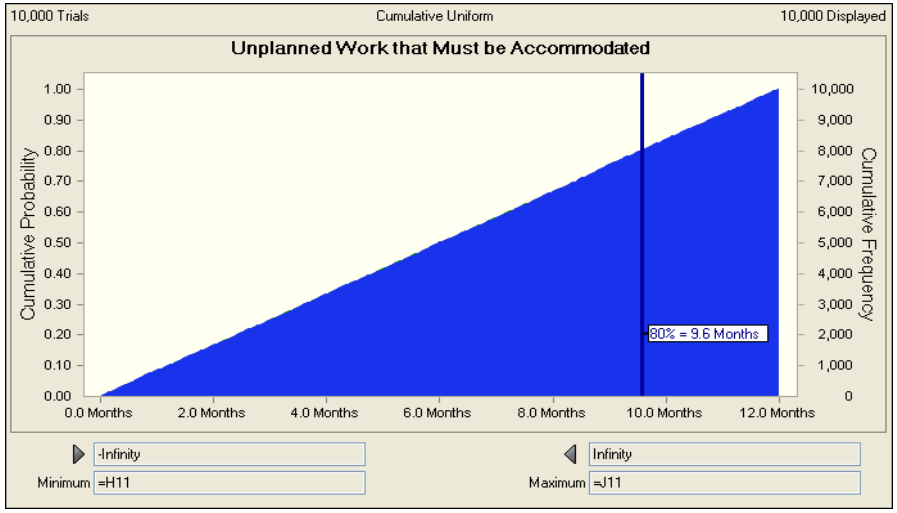
Risk Refer No.	Risk Event	Low	Most Likely	High
PPM-3	Unplanned Work that Must be Accommodated	0.0 Months	0.0 Months	12.0 Months

Notes: This item captures the risk that will cause a variance from the baseline schedule for the project.

Likely Likely assumes no change from the baseline schedule.

Low Assumes no time savings from baseline if there is not any umplanned work

High Assumes 12 month delay from baseline due to unplanned work



Assumption: **Unplanned Work that Must be Accommodated**

Percentile	Assumption values
0%	0.0 Months
10%	1.2 Months
20%	2.4 Months
30%	3.6 Months
40%	4.8 Months
50%	6.0 Months
60%	7.2 Months
70%	8.4 Months
80%	9.6 Months
90%	10.8 Months
100%	12.0 Months

MVP - Fargo/Moorhead Feasibility Report (North Dakota Option) - Schedule Risk Analysis Model

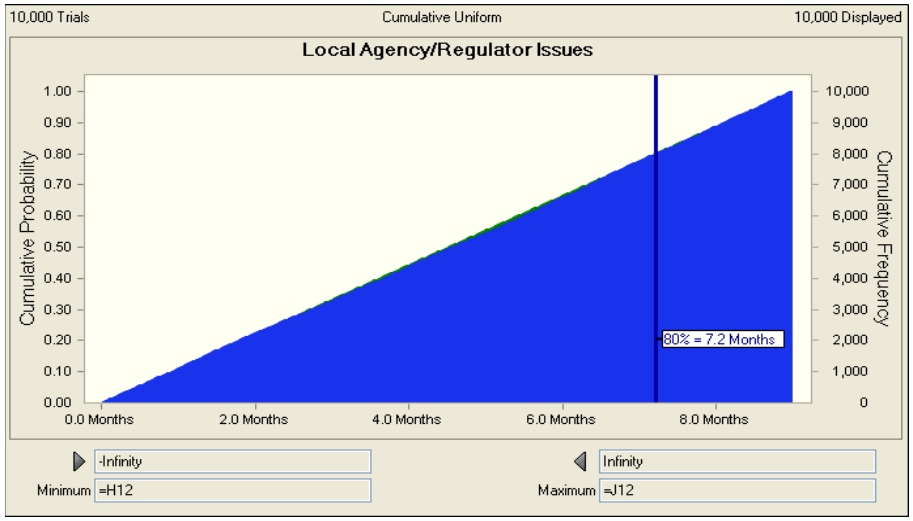
Risk Refer No.	Risk Event	Low	Most Likely	High
PPM-4	Local Agency/Regulator Issues	0.0 Months	0.0 Months	12.0 Months

Notes: This item captures the risk that will cause a variance from the baseline schedule for the project.

Likely Likely assumes no change from the baseline schedule.

Low Assumes no time savings from baseline if the resource agencies accept the project as currently designed and do not require changes to the design flows

High Assumes 12 month delay from baseline due to agency / regulator issues requiring changes to the design flow rates



Assumption: **Local Agency/Regulator Issues**

Percentile	Assumption values
0%	0.0 Months
10%	0.9 Months
20%	1.8 Months
30%	2.7 Months
40%	3.7 Months
50%	4.6 Months
60%	5.5 Months
70%	6.4 Months
80%	7.2 Months
90%	8.1 Months
100%	9.0 Months

MVP - Fargo/Moorhead Feasibility Report (North Dakota Option) - Schedule Risk Analysis Model

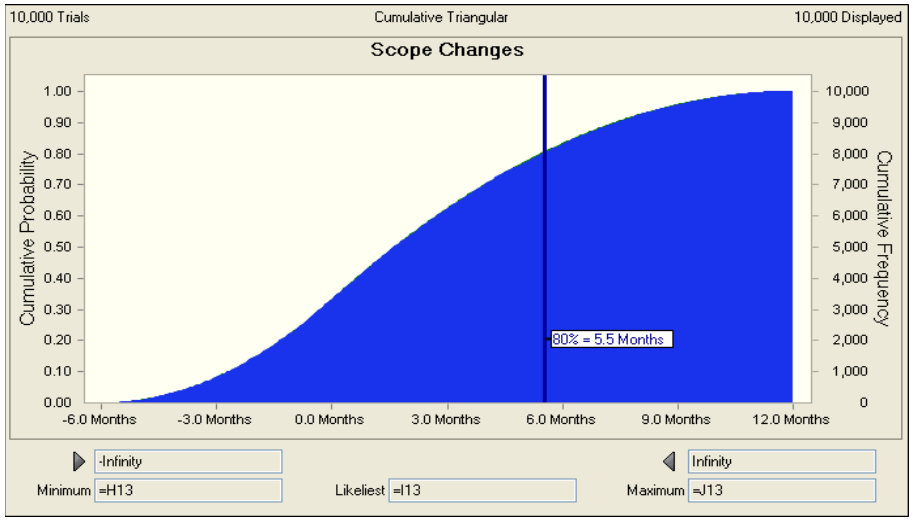
Risk Refer No.	Risk Event	Low	Most Likely	High
PPM-8	Scope changes	-6.0 Months	0.0 Months	12.0 Months

Notes: This item captures the risk that will cause a variance from the baseline schedule for the project.

Likely Likely assumes no change from the baseline schedule.

Low Assumes scope changes decrease project features and schedule.

High Assumes scope changes increase project features, footprint and schedule.



Assumption: **Scope changes**

Percentile	Assumption values
0%	'-5.9 Months
10%	'-2.7 Months
20%	'-1.3 Months
30%	'-0.3 Months
40%	0.7 Months
50%	1.6 Months
60%	2.7 Months
70%	4.0 Months
80%	5.5 Months
90%	7.5 Months
100%	11.8 Months

MVP - Fargo/Moorhead Feasibility Report (North Dakota Option) - Schedule Risk Analysis Model

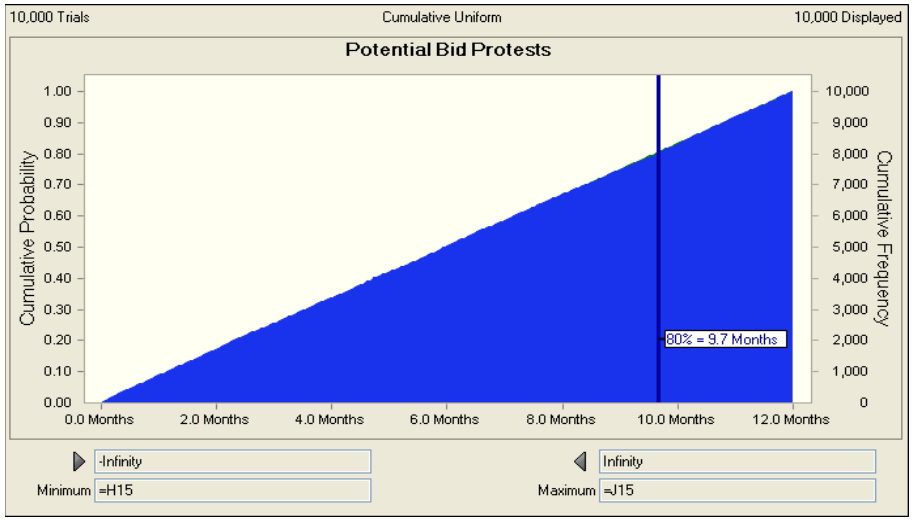
Risk Refer No.	Risk Event	Low	Most Likely	High
CA-4	Potential Bid Protests	0.0 Months	0.0 Months	12.0 Months

Notes: This item captures the risk that will cause a variance from the baseline schedule for the project.

Likely Likely assumes no change from the baseline schedule.

Low Assumes no time savings from baseline if there are not any bid protests

High Assumes 12 month delay from baseline due to bid protests delaying work



Assumption: **Potential Bid Protests**

Percentile	Assumption values
0%	0.0 Months
10%	1.1 Months
20%	2.3 Months
30%	3.6 Months
40%	4.7 Months
50%	6.0 Months
60%	7.2 Months
70%	8.4 Months
80%	9.7 Months
90%	10.8 Months
100%	12.0 Months

MVP - Fargo/Moorhead Feasibility Report (North Dakota Option) - Schedule Risk Analysis Model

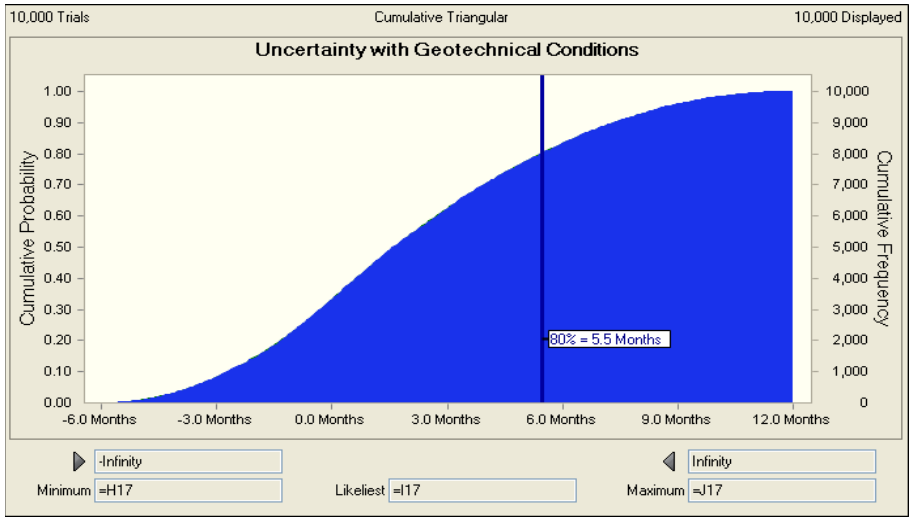
Risk Refer No.	Risk Event	Low	Most Likely	High
TL-1	Uncertainty with Geotechnical Conditions	-6.0 Months	0.0 Months	6.0 Months

Notes: This item captures the risk that will cause a variance from the baseline schedule for the project.

Likely Likely assumes no change from the baseline schedule.

Low Assumes that best case geotechnical conditions allow construction to advance by 6 months

High Assumes that uncertainty with geotechnical condtions causes 6 month delay in construction



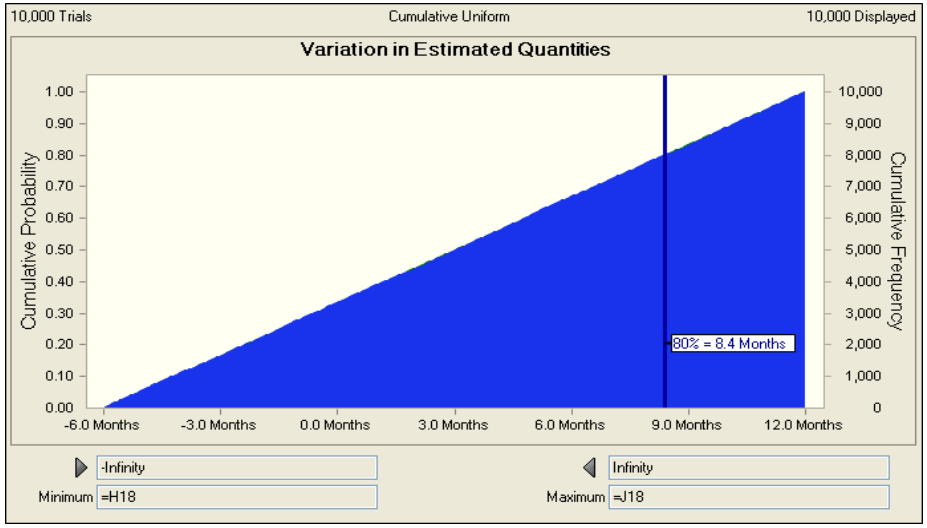
Assumption: **Uncertainty with Geotechnical Conditions**

Percentile	Assumption values
0%	'-5.9 Months
10%	'-2.7 Months
20%	'-1.3 Months
30%	'-0.3 Months
40%	0.6 Months
50%	1.6 Months
60%	2.8 Months
70%	4.0 Months
80%	5.5 Months
90%	7.4 Months
100%	11.9 Months

MVP - Fargo/Moorhead Feasibility Report (North Dakota Option) - Schedule Risk Analysis Model

Risk Refer No.	Risk Event	Low	Most Likely	High
TL-5	Variation in Estimated Quantities	-6.0 Months	0.0 Months	12.0 Months

Notes: This item captures the risk that will cause a variance from the baseline schedule for the project.
Likely Likely assumes no change from the baseline schedule.
Low Assumes quantities are less than baseline and schedule is shortened
High Assumes quantities are greater than baseline and causes an increase in the schedule



Assumption: **Variation in Estimated Quantities**

Percentile	Assumption values
0%	'-6.0 Months
10%	'-4.2 Months
20%	'-2.4 Months
30%	'-0.6 Months
40%	1.2 Months
50%	3.0 Months
60%	4.8 Months
70%	6.6 Months
80%	8.4 Months
90%	10.2 Months
100%	12.0 Months

MVP - Fargo/Moorhead Feasibility Report (North Dakota Option) - Schedule Risk Analysis Model

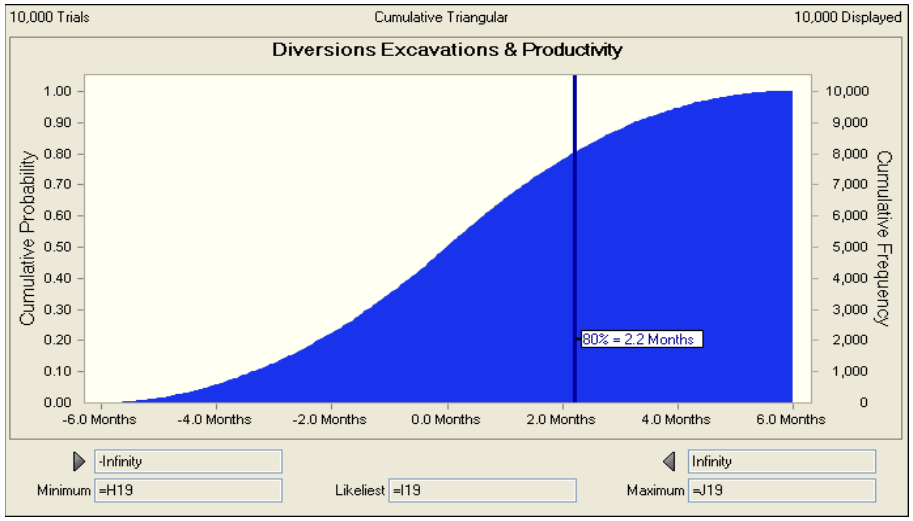
Risk Refer No.	Risk Event	Low	Most Likely	High
TL-11	Diversions	-6.0 Months	0.0 Months	12.0 Months

Notes: This item captures the risk that will cause a variance from the baseline schedule for the project.

Likely Likely assumes no change from the baseline schedule.

Low Assumes diverson alignment changes decrease footprint and quantities making for a shorter schedule than the baseline

High Assumes diverson alignment changes increase footprint and quantities making for a longer schedule than the baseline



Assumption: **Diversions**

Percentile	Assumption values
0%	'-5.9 Months
10%	'-3.4 Months
20%	'-2.2 Months
30%	'-1.4 Months
40%	'-0.6 Months
50%	0.0 Months
60%	0.6 Months
70%	1.4 Months
80%	2.2 Months
90%	3.3 Months
100%	5.9 Months

MVP - Fargo/Moorhead Feasibility Report (North Dakota Option) - Schedule Risk Analysis Model

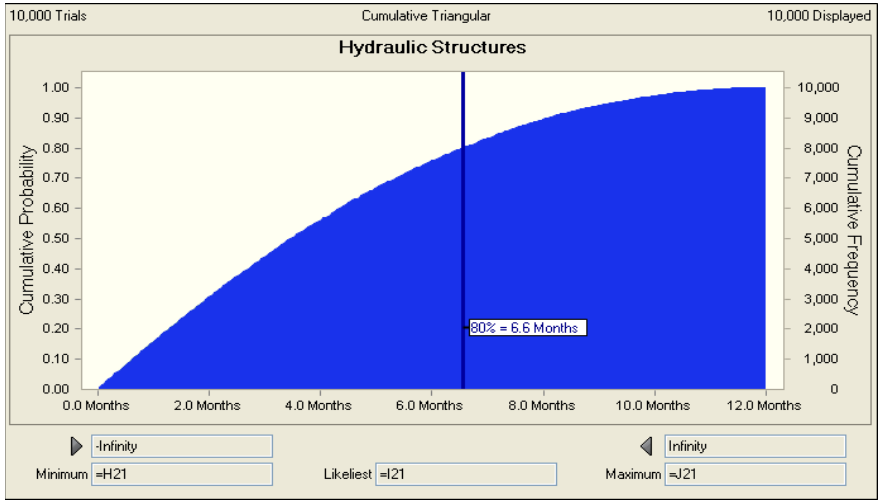
Risk Refer No.	Risk Event	Low	Most Likely	High
TL-12	Hydraulic Structures	0.0 Months	0.0 Months	12.0 Months

Notes: This item captures the risk that will cause a variance from the baseline schedule for the project.

Likely Likely assumes no change from the baseline schedule.

Low Assumes model studies of hydraulic structures shows that cuurent design is adequate or that structures can be smaller. However smaller structures would probably not reduce the project schedule from the baseline since channel excavation would most likely be controlling

High Assumes model studies of hydraulic structures shows that cuurent design is not adequate and that structures should be larger. Additional design and construction time may result



Assumption: **Hydraulic Structures**

Percentile	Assumption values
0%	0.0 Months
10%	0.6 Months
20%	1.3 Months
30%	2.0 Months
40%	2.7 Months
50%	3.5 Months
60%	4.3 Months
70%	5.4 Months
80%	6.6 Months
90%	8.1 Months
100%	11.9 Months

MVP - Fargo/Moorhead Feasibility Report (North Dakota Option) - Schedule Risk Analysis Model

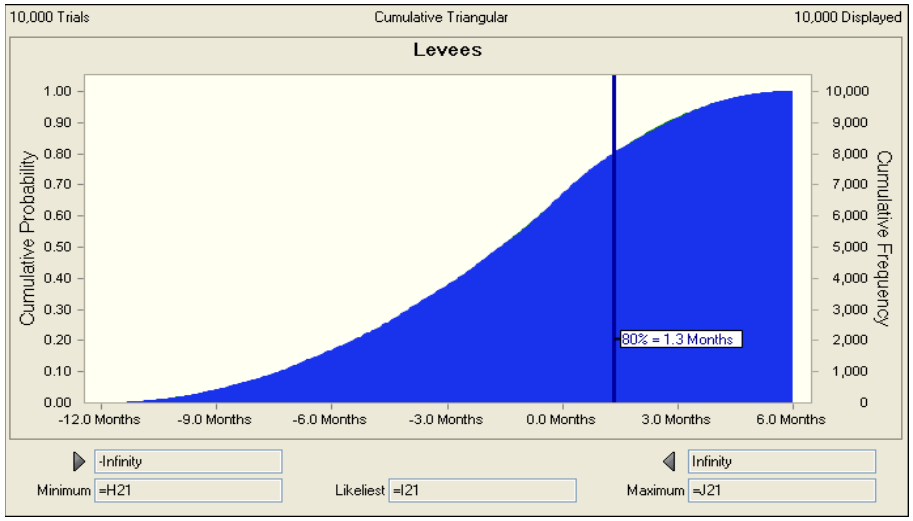
Risk Refer No.	Risk Event	Low	Most Likely	High
TL-13	Levees	-12.0 Months	0.0 Months	0.0 Months

Notes: This item captures the risk that will cause a variance from the baseline schedule for the project.

Likely Likely assumes no change from the baseline schedule.

Low Assumes required staging areas are less which decreases project footprint and quantities and leads to a less and smaller levees and a shorter schedule than baseline

High Assumes required staging areas will not be greater footprint than currently modeled



Assumption: **Levees**

Percentile	Assumption values
0%	'-11.9 Months
10%	'-7.4 Months
20%	'-5.4 Months
30%	'-4.0 Months
40%	'-2.7 Months
50%	'-1.6 Months
60%	'-0.6 Months
70%	0.3 Months
80%	1.3 Months
90%	2.8 Months
100%	5.9 Months

MVP - Fargo/Moorhead Feasibility Report (North Dakota Option) - Schedule Risk Analysis Model

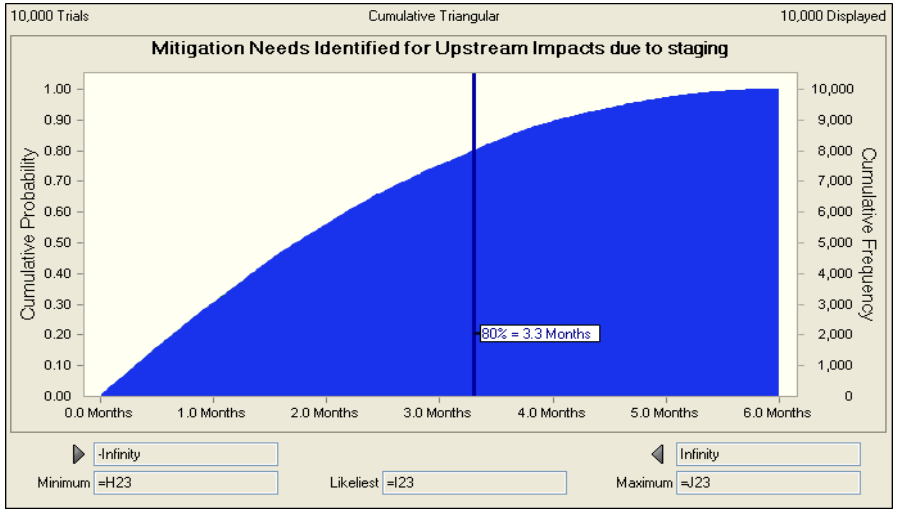
Risk Refer No.	Risk Event	Low	Most Likely	High
LD-1	Mitigation Needs Identified for Upstream Impacts due to staging	0.0 Months	0.0 Months	12.0 Months

Notes: This item captures the risk that will cause a variance from the baseline schedule for the project.

Likely Likely assumes no change from the baseline schedule.

Low Assumes no change from baseline if additional upstream mitigation is not required from the baseline project plan

High Assumes delay in project to mitigate impacts to areas upstream.



Assumption: **Mitigation Needs Identified for Upstream Impacts due to staging**

Percentile	Assumption values
0%	0.0 Months
10%	0.3 Months
20%	0.6 Months
30%	1.0 Months
40%	1.3 Months
50%	1.7 Months
60%	2.2 Months
70%	2.7 Months
80%	3.3 Months
90%	4.0 Months
100%	6.0 Months

MVP - Fargo/Moorhead Feasibility Report (North Dakota Option) - Schedule Risk Analysis Model

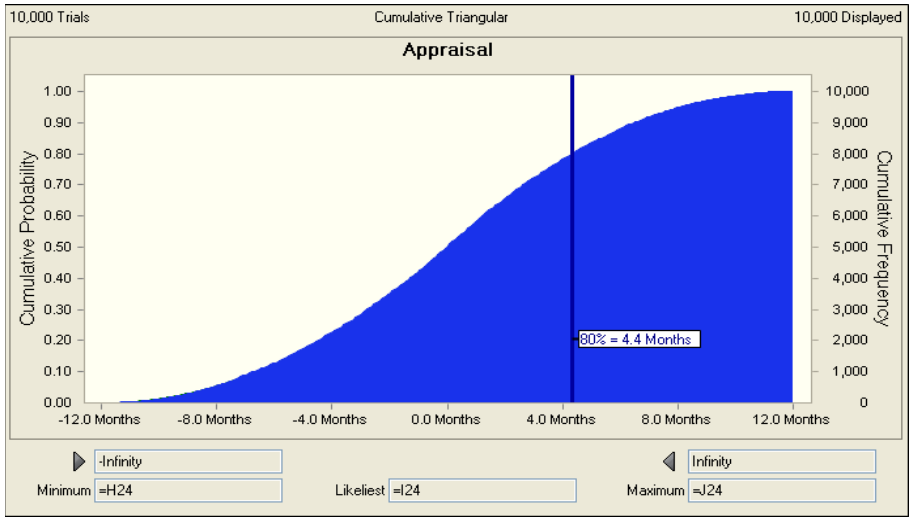
Risk Refer No.	Risk Event	Low	Most Likely	High
LD-4	Appraisal	-12.0 Months	0.0 Months	12.0 Months

Notes: This item captures the risk that will cause a variance from the baseline schedule for the project.

Likely Likely assumes no change from the baseline schedule.

Low Assumes that project schedule can decrease if appraisals go smoothly

High Assumes that project schedule can increases if appraisals go take longer



Assumption: **Appraisal**

Percentile	Assumption values
0%	'-11.9 Months
10%	'-6.7 Months
20%	'-4.5 Months
30%	'-2.8 Months
40%	'-1.3 Months
50%	0.0 Months
60%	1.2 Months
70%	2.7 Months
80%	4.4 Months
90%	6.5 Months
100%	11.9 Months

MVP - Fargo/Moorhead Feasibility Report (North Dakota Option) - Schedule Risk Analysis Model

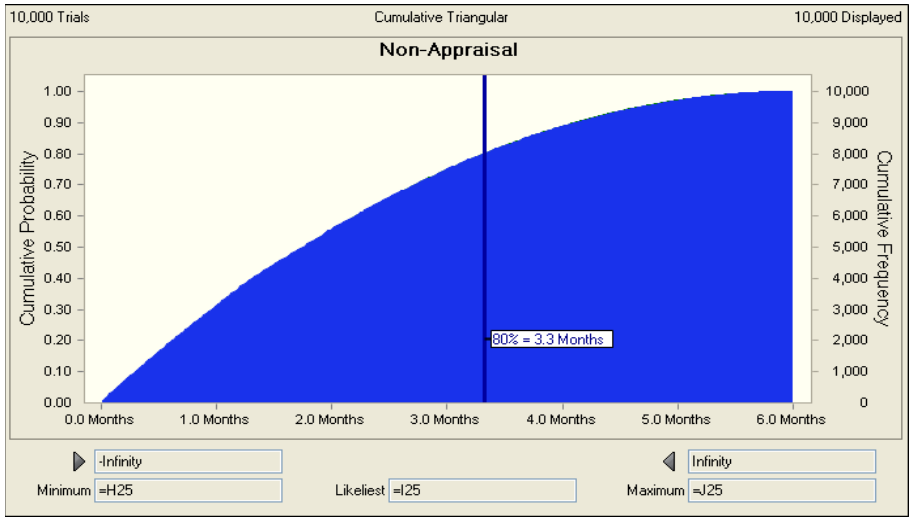
Risk Refer No.	Risk Event	Low	Most Likely	High
LD-5	Non-Appraisal	0.0 Months	0.0 Months	6.0 Months

Notes: This item captures the risk that will cause a variance from the baseline schedule for the project.

Likely Likely assumes no change from the baseline schedule.

Low Assumes that project schedule can will not change if there are not any non-appraisals issues

High Assumes that project schedule can increase if non-appraisal issues delay project



Assumption: **Non-Appraisal**

Percentile	Assumption values
0%	0.0 Months
10%	0.3 Months
20%	0.6 Months
30%	1.0 Months
40%	1.3 Months
50%	1.8 Months
60%	2.2 Months
70%	2.7 Months
80%	3.3 Months
90%	4.1 Months
100%	6.0 Months

MVP - Fargo/Moorhead Feasibility Report (North Dakota Option) - Schedule Risk Analysis Model

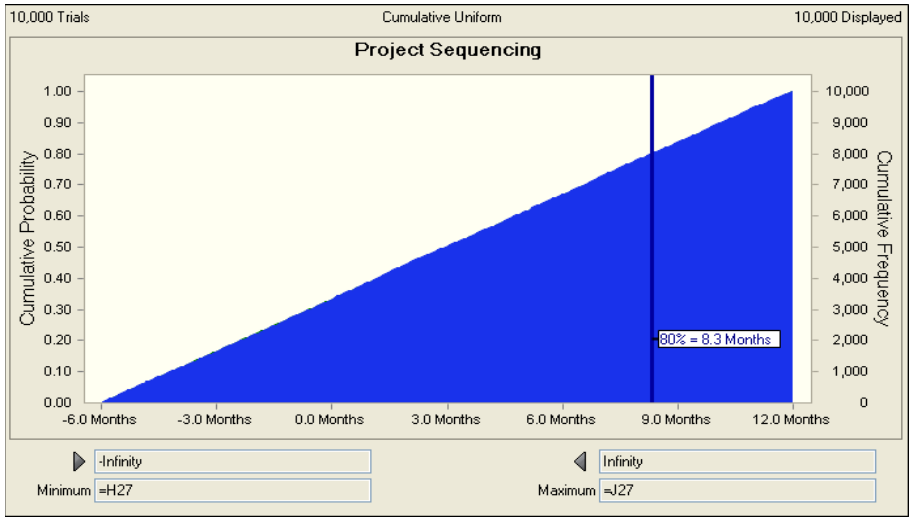
Risk Refer No.	Risk Event	Low	Most Likely	High
CON-5	Project Sequencing	-6.0 Months	0.0 Months	12.0 Months

Notes: This item captures the risk that will cause a variance from the baseline schedule for the project.

Likely Likely assumes no change from the baseline schedule.

Low Assumes project sequencing save time for schedule

High Assumes delay in project schedule if conflicts develop between contractors



Assumption: **Project Sequencing**

Percentile	Assumption values
0%	'-6.0 Months
10%	'-4.2 Months
20%	'-2.3 Months
30%	'-0.6 Months
40%	1.2 Months
50%	2.9 Months
60%	4.8 Months
70%	6.6 Months
80%	8.3 Months
90%	10.1 Months
100%	12.0 Months

MVP - Fargo/Moorhead Feasibility Report (North Dakota Option) - Schedule Risk Analysis Model

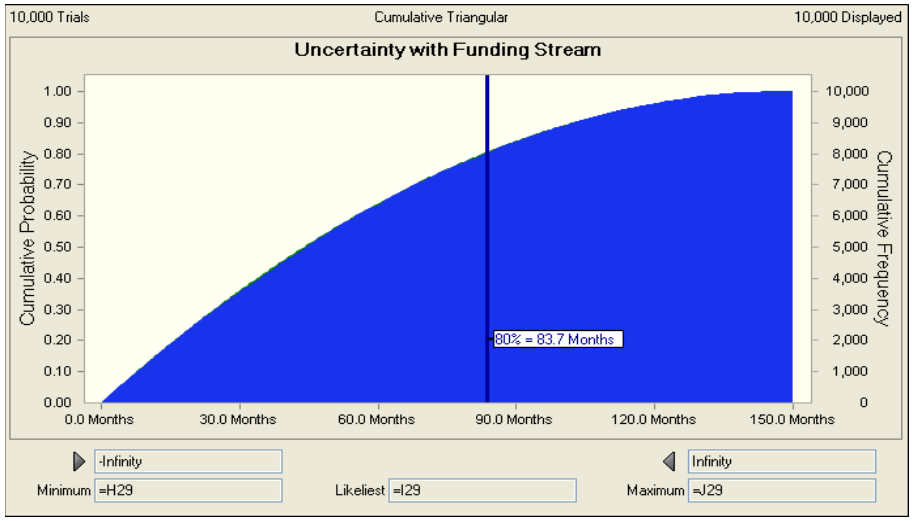
Risk Refer No.	Risk Event	Low	Most Likely	High
PR-1	Uncertainty with Funding Stream	0.0 Months	0.0 Months	150.0 Months

Notes: This item captures the risk that will cause a variance from the baseline schedule for the project.

Likely Likely assumes no change from the baseline schedule.

Low Assumes that funding will not be higher than the proposed project schedule

High Assumes that funding will be at the alternate funding of schedule of approximately $80M/year which may take an additional 12-13 years to complete the project



Assumption: **Uncertainty with Funding Stream**

Percentile	Assumption values
0%	0.0 Months
10%	8.1 Months
20%	16.2 Months
30%	25.1 Months
40%	34.6 Months
50%	44.7 Months
60%	55.4 Months
70%	68.2 Months
80%	83.7 Months
90%	102.9 Months
100%	148.3 Months

MVP - Fargo/Moorhead Feasibility Report (North Dakota Option) - Schedule Risk Analysis Model

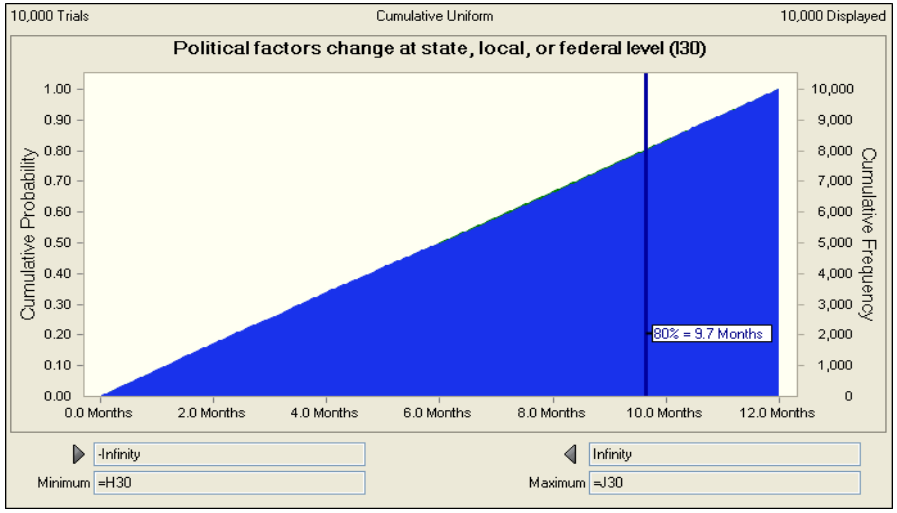
Risk Refer No.	Risk Event	Low	Most Likely	High
PR-4	Political factors change at state, local, or federal level	0.0 Months	0.0 Months	12.0 Months

Notes: This item captures the risk that will cause a variance from the baseline schedule for the project.

Likely Likely assumes no change from the baseline schedule.

Low Assumes the baseline schedule when there is not any political oppisition

High Assumes the political factors cause an increase from the baseline project schedule



Assumption: **Political factors change at state, local, or federal level**

Percentile	Assumption values
0%	0.0 Months
10%	1.2 Months
20%	2.3 Months
30%	3.5 Months
40%	4.8 Months
50%	6.1 Months
60%	7.3 Months
70%	8.5 Months
80%	9.7 Months
90%	10.8 Months
100%	12.0 Months

MVP - Fargo/Moorhead Feasibility Report (North Dakota Option) - Schedule Risk Analysis Model

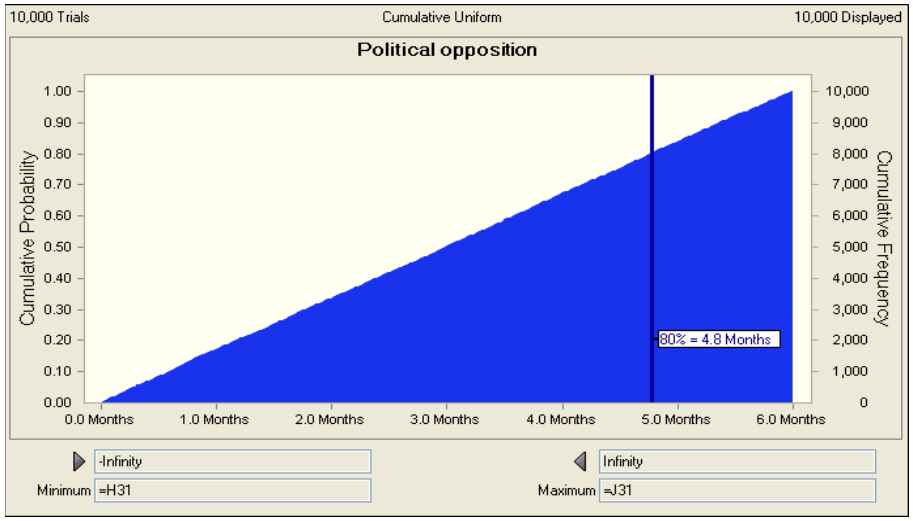
Risk Refer No.	Risk Event	Low	Most Likely	High
PR-5	Political opposition	0.0 Months	0.0 Months	6.0 Months

Notes: This item captures the risk that will cause a variance from the baseline schedule for the project.

Likely Likely assumes no change from the baseline schedule.

Low Assumes the baseline schedule when there is not any political oppisition from Federal agencies.

High Assume an increase in the schedule due to political oppisition from Federal agencies



Assumption: **Political opposition**

Percentile	Assumption values
0%	0.0 Months
10%	0.6 Months
20%	1.2 Months
30%	1.8 Months
40%	2.4 Months
50%	3.0 Months
60%	3.6 Months
70%	4.2 Months
80%	4.8 Months
90%	5.4 Months
100%	6.0 Months

MVP - Fargo/Moorhead Feasibility Report (North Dakota Option) - Schedule Risk Analysis Model

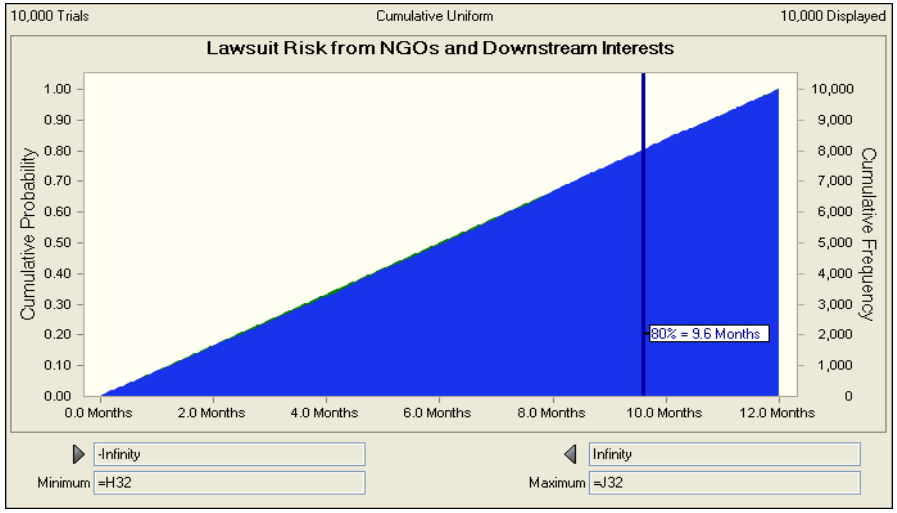
Risk Refer No.	Risk Event	Low	Most Likely	High
PR-6	Lawsuit Risk from NGOs and Downstream Interests	0.0 Months	0.0 Months	12.0 Months

Notes: This item captures the risk that will cause a variance from the baseline schedule for the project.

Likely Likely assumes no change from the baseline schedule.

Low Assumes the baseline schedule when there are not any lawsuits from upstream interest

High Assumes an increase in the schedule due to lawsuits from upstream interest that delay the project



Assumption: **Lawsuit Risk from NGOs and Downstream Interests**

Percentile	Assumption values
0%	0.0 Months
10%	1.3 Months
20%	2.5 Months
30%	3.7 Months
40%	4.9 Months
50%	6.1 Months
60%	7.3 Months
70%	8.4 Months
80%	9.6 Months
90%	10.8 Months
100%	12.0 Months