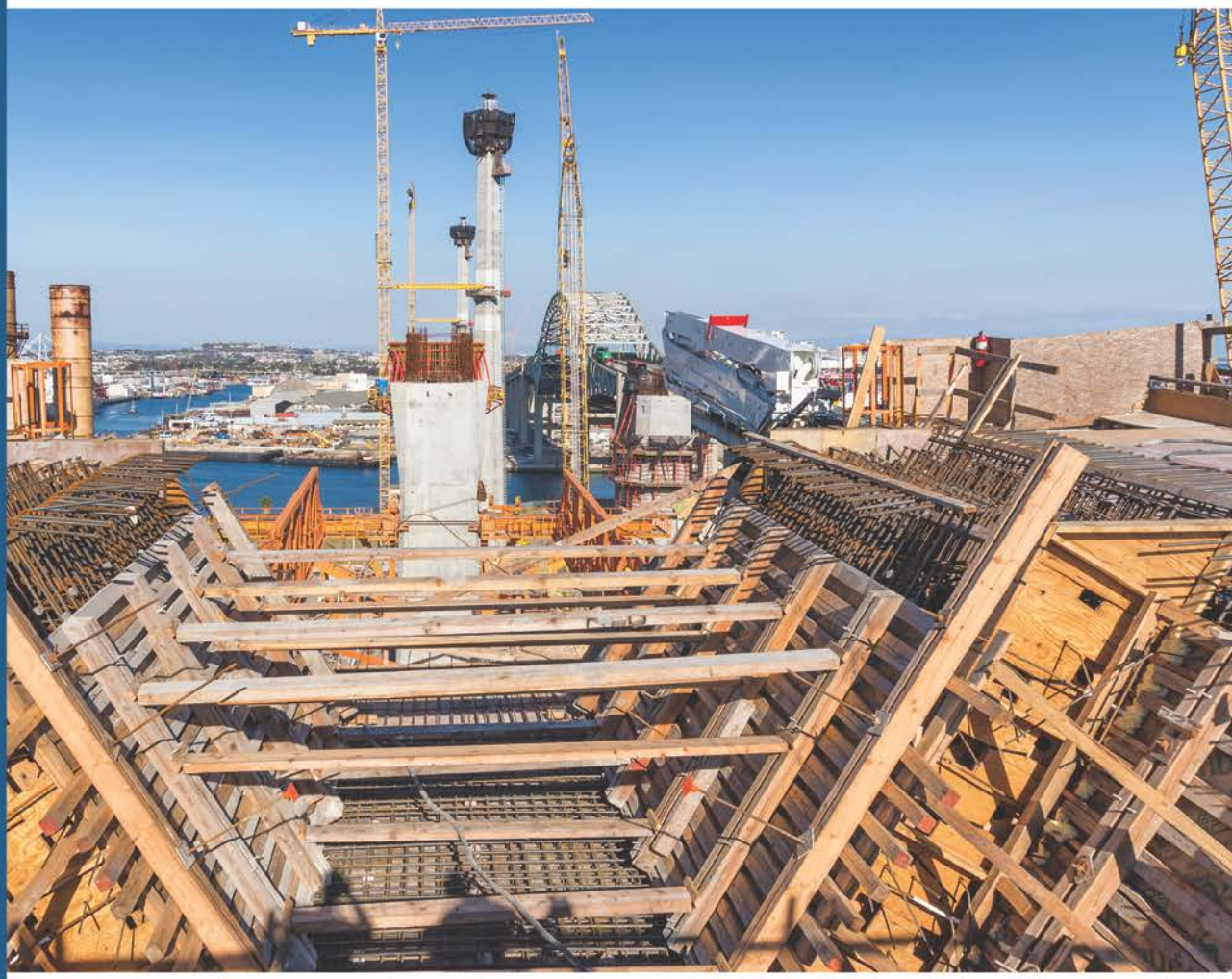
Project Delivery Risk Management Manual



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1 POLB RAAM OVERVIEW

As part of its standard project delivery process, the Port of Long Beach (POLB) adopted the Risk Assessment, Analysis, and Mitigation (RAAM) techniques. RAAM procedures are a project management best practice used in most high-risk, high-consequence industries, including nuclear, aerospace, oil and gas, and transportation to identify and manage risks. The RAAM process is an integral part of quality management.

A risk is an uncertain event or condition that, if it occurs, has a positive or negative effect on at least one project objective. A risk may have one or more causes and, if it occurs, one or more impacts. To effectively manage uncertainty risks should be considered throughout the life of a project.

Project risk management at POLB is integrated into all project phases from project planning through engineering and construction to warranty and maintenance. The benefit on project delivery is to assist in proactive management of risks, develop project contingencies, increase predictability, utilize past experiences and develop a culture for mutual project solving.

Accountability is critical. Typically, Project Managers manage risks, but risk owners may also be assigned individually for specific risks and opportunities. Risks associated with project risk assessments should not be confused with insurance, liability, or injury, which are managed by the Port's Risk Management Division within the Finance & Administration Bureau, although project risks may affect any of these elements.

1.1 RAAM Objectives

Programs and projects within the POLB's Capital Improvement Program (CIP) — must be delivered under tight budget and schedule constraints using innovative designs, integrated new technologies, strong environmental mitigations, and sustainable development practices.

RAAM procedures are designed not only to ensure that all project risks and their mitigations are considered, but also to identify opportunities to reduce both cost and schedule implications. The multi-level (policy, program, project) risk assessments are an essential tool in determining risk-adjusted contingencies for the overall budget and schedule.

Program and Project Managers (PM) together with their project teams shall use the RAAM process to identify project trade-offs and make informed decisions.

Table 1-1 RAAM Objectives

RAMM Objectives	
1) Mitigate adverse impacts to the project cost (hard and labor) and schedule	4) Identify project priority areas
2) Maximize opportunities to improve project outcomes	5) Minimize disruptive unexpected events and change orders
3) Develop a risk-adjusted budget contingency estimate for the overall project budget and schedule	6) Reinforce Lessons Learned from the past

2 RAAM PROCESS

RAAM involves processes, tools, and techniques that help Project Managers minimize probability and consequences of adverse impacts to projects and maximize opportunities. Project risk assessments are most effective when performed early in the project planning phase. This manual provides a systematic approach to project risk assessment and management and allows the project team to address uncertainty proactively and consistently throughout a project.

The risk assessment and management system adopted by POLB is based on the ISO 31000 Risk management – Guidelines standard and industry best practices and aligned with the Committee of Sponsoring Organizations of the Treadway Commission (COSO) framework

2.1 POLB Project Delivery and RAAM

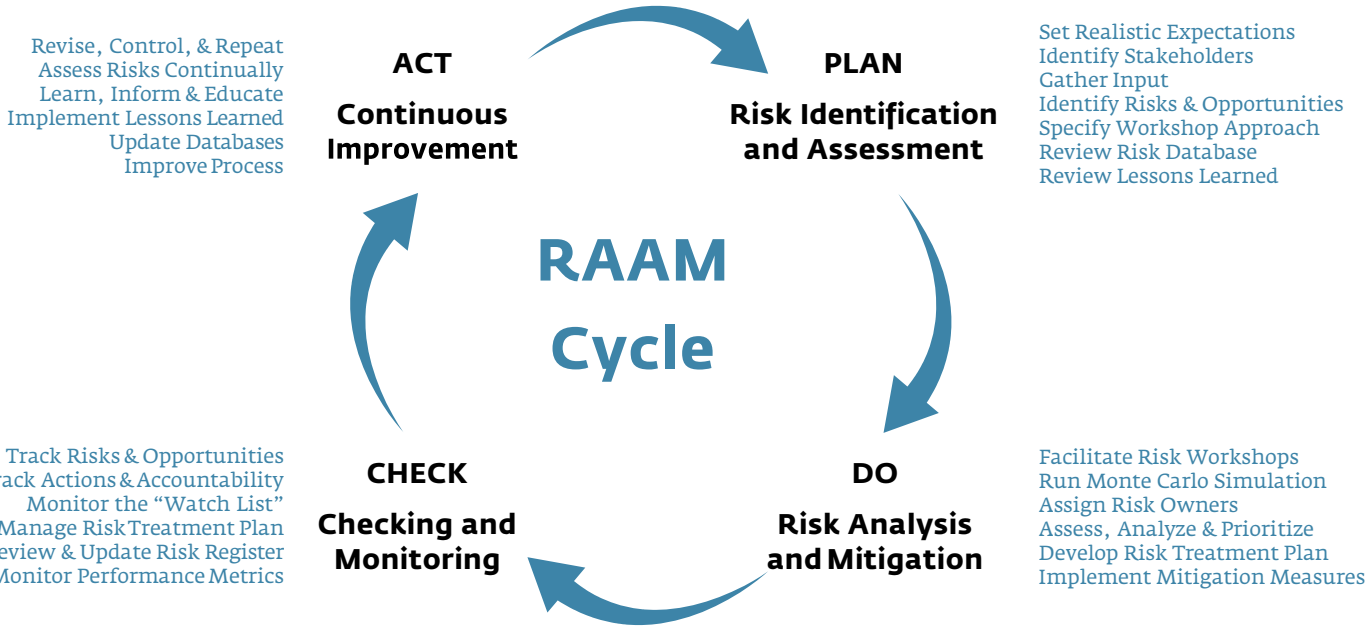
The RAAM process is integrated into the POLB's Project Delivery Process. At a minimum, each project must ensure the following items are completed at each delivery phase:

Table 2-1 RAAM Process

Project Initiation	Preliminary Design	Final Design	Bid & Award	Construction	Close-Out
High level risk identification	Assessment of risk and register development – conduct risk assessment workshop Risk Impact Summary/ Risk analysis – Monte Carlo simulation Risk Mitigation – develop risk treatment plan	Risk assessment update and management at 50%, 100% and final design Risk assessment and risk treatment plan update	Risk assessment management Update risk register and risk treatment plan	Risk assessment management Update risk register and risk treatment plan	Final review of the effectiveness of the risk register Continuous Improvement – Lessons Learned Reporting

2.2 RAAM Process and Description

The graphic below represents an overview of the Port's RAAM Cycle. The key elements of this approach include risk identification, assessment, analysis, mitigation, tracking, managing, and continuous improvement arranged in the Act-Plan-Do-Check continuous feedback loop.



3 RISK ASSESSMENT

3.1 Risk Assessment Planning

It takes time, resources, and organizational support to collect accurate data related to project risk. Data for the risk assessments are often based on the judgment and expertise of informed individuals. Examples of the data to collect may include:

- Contractual information, such as tenant requirements, city agreements, and leases.
- Technical data, such as plans, specifications, and regulatory requirements.
- Risk and vulnerability assessments and sea level rise mapping in the Climate Adaptation and Coastal Resiliency Plan
- Project schedule and budget, including hard and labor cost estimates, and Port budgets.
- Lessons learned from previous projects.
- Risk database to include risks identified on similar projects.
- Other relevant information, including adjacent projects or federal funding requirement.

The project team must identify stakeholders, both internal and external, and engage them in the process. Stakeholders are those organizations, agencies, departments, and groups that can influence or affect the successful completion of the project. While the Project Manager may not have control over stakeholder participation, reaching out to all identified is essential. Stakeholders often see the projects in very different ways and can help identify risks that may not otherwise be recognized but may have a profound impact on the program or project at hand.

The composition of the risk assessment team is essential. Risk workshops typically include:

- Project Manager, Risk Coordinator, and Outside Facilitator (as needed)
- Representatives of disciplines, including but not limited to Engineering Design, Construction, Environmental, Planning, Real Estate, Utilities, Risk Management, including Port staff, consultants, and external stakeholders

Team members involved in the initial workshop should participate in the subsequent workshops, as needed.

Risk workshops are led by a risk facilitator, either in-house or third-party, depending on the scope of the project. The risk facilitator reviews the project, scope supports gathering relevant data, facilitates clear and effective dialogue amongst workshop participants, and captures a clear record of the information for analysis to quantify project risks. Additionally, the facilitator develops a risk mitigation management plan to be utilized by the PM throughout the delivery process.

3.2 Risk Assessment Guidelines

All projects must be assessed to determine the level of complexity and risk. There are three levels identified for projects and the associated roles and responsibilities throughout the risk assessment process. Project levels are generally determined by the size and valuation of the project. However, other factors such as complexity, political sensitivity, unique budget and schedule constraints, climate considerations and the profile of the project are also considered to determine the best approach to the risk assessment process.

Table 3-1 Risk Assessment Process

Project Construction Valuation	Risk Assessment Process	Roles & Responsibilities
Level 1: <$5M	High level risk assessment and mitigation Complete abbreviated risk register and quantitative analysis	Project Manager populates, monitors, and updates Risk Register, with assistance from Risk Coordinator (Program Management Office) including both cost and schedule impacts. A Risk Impact Summary is prepared.
Level 2: between $5M and $20M	Complete Risk Register with formal workshop and quantitative analysis	Project Manager, with assistance from Risk Coordinator (Program Management Office), holds formal risk workshops, populates, monitors, and updates Risk Register including both cost and schedule impacts and either a Risk Impact Summary or a Monte Carlo Simulation is prepared
Level 3: >$20M	Complete Risk Register with formal workshop and quantitative analysis	Project Manager, with assistance from Risk Coordinator (Program Management Office), holds formal risk workshops, populates, monitors, and updates Risk Register including both cost and schedule impacts and a Monte Carlo Simulation is prepared.

3.3 Risk Identification

The risk identification phase involves gathering and categorizing risks into a risk register. See Appendix 10.4 Sample Risk Register. During this phase, the project team should not only gather stakeholder inputs and group them into relevant categories, but also review databases of risk inventory and lessons learned.

Appendix 10.1 provides a Risk Brainstorming Prompt List with examples of threats and opportunities. When identifying risks, the project team should also consider triggers, secondary risks, residual risks, climate change adaptation risks and risk interaction. At the minimum, the information needed for each risk prior to the risk workshop should include a risk description. Impacts to schedule and budget and mitigation strategies can be specified prior to or during the workshop, whenever feasible. Hard and labor costs must be estimated separately.

The risk register should be drafted several weeks in advance of the workshop and circulated among stakeholders for comments. This process allows ample time for consideration of the potential risks and impacts. For less complex projects, the input from stakeholders can be collected during workshops.

Upon completion of the initial risk assessment, the project team develops a plan of action to address identified risks and their treatment options. The plan specifies due dates and accountability. On rare occasions, particularly on highly complex projects, risk assessments may require considerations of various scenarios and multiple consequences for each scenario. Identifying opportunities can improve the outcome of a project and eliminate or reduce the negative impact of a risk. In some cases, the risks may be turned into opportunities.

3.4 Risk Context

The risk context defines the scope or boundary of the risk assessment to ensure a focused approach to risk. Any project can have hundreds of risks, but the process of determining the context helps to narrow them down to those risks that are more likely and have bigger impacts, rather than small or unlikely risks. To help define the context, the project team should also develop a concise statement and a list of key success factors prior to the risk workshop.

Factors Affecting Success of the Project that Help Frame Discussions

On-budget and on-time project delivery	Quality work	Zero harm to people, assets and environment	Ongoing uninterrupted Port operation

3.5 Likelihood and Consequence Table

The Port adopted five-level scales to determine risk likelihood and consequence and four risk levels for the qualitative risk assessment and analysis, as shown in the table below.

Table 3-2 Risk Level Assessment

			Consequence				
			Insignificant	Minor	Moderate	Major	Catastrophic
			1	2	3	4	5
Likelihood	A	Almost Certain	High	High	Extreme	Extreme	Extreme
	B	Likely	Moderate	High	High	Extreme	Extreme
	C	Moderate	Low	Moderate	High	Extreme	Extreme
	D	Unlikely	Low	Low	Moderate	High	Extreme
	E	Rare	Low	Low	Moderate	High	High

The project team should determine the appropriate project scale using the likelihood and consequence table before the risk assessment. See Appendix 10.8 Sample of the Likelihood and Consequence Table. Relevant sections in the table, primarily financial and schedule, should be reviewed and adjusted for each project. The borderline values at the consequence scale should be carefully offset to avoid confusion and impacts on the risk severity. Project teams use the scale to evaluate each risk.

3.6 Workshops

The risk assessment team meets in person at risk workshops to assess the identified risks and develop the risk register. Assessments performed in a multi-disciplined and diversified environment result in more effective risk assessments. The types of workshops include:

Table 3-3 Types of Workshops

Workshops	Description
• Initial workshop	• The first project risk assessment workshop
• Follow-up workshop	• An update to the risk register as the project moves forward
• Risk register update meetings	• Not formal workshops but regular project team meetings to update the risk register and monitor project risks

During initial workshops, the team typically starts with reviewing all identified risks before evaluating them. New risks and opportunities can be added, and not applicable risks should be removed. When a project reaches a certain milestone, a follow up workshop is required. The team performs a thorough review of the previous risk register, adds or eliminates risks, and evaluates them. Risk register update meetings suffice for less complex projects and certain project phases, such as project close-out.

The duration of workshops depends on the project complexity. Key elements include pre-workshop planning, coordination, and post-workshop analysis. The shorter the workshop, the more upfront and post- workshop work are necessary. Incomplete risk assessments may lead to missed threats, lost opportunities, and even residual or secondary project risks. For better results, risk workshops should be scheduled in advance, long before the project approaches a certain completion percentage. The appropriate planning will increase the productivity of workshops and their outcomes.

Table 3-4 Risk Assessment Steps

Risk Assessment				
1) Initiate a kick-off meeting/call.	2) Identify new risks.	3) Develop a draft risk register with potential mitigation strategies.	4) Gather stakeholder input.	5) Revise the Likelihood and Consequence Scale.
6) Facilitate a risk workshop. Focus on risk severity before and after treatment.	7) Assess risks. Update the risk register.	8) Run Monte Carlo simulation.	9) Prepare a report.	10) Monitor and review risks and mitigations throughout the life of the project.

4 RISK REGISTER

A risk register documents the identified risks. Each identified risk should include its description with the risk severity before and after treatment. The risk severity reflects the risk level, e.g., extreme, high, moderate, or low. It specifies the risk consequence and likelihood of its occurrence. It shall also include existing controls, treatment plan, risk response strategies, assigned risk owners, the cost of treatment, and the overall risk rating of each risk. Risk ratings and ranks frequently change during the project lifecycle. See the Sample Risk Register in Appendix 10.4.

A risk register is a living document, not a static tool, which should be monitored, reviewed, and updated regularly. At a minimum, a risk register should be evaluated and revised at each major project milestone and if a new element has been introduced into the project or if a major scope element has changed. Project Managers should ensure that the data entered into the risk register at each project phase is complete.

The risk register includes multiple tools for risk evaluation, such as Risk Maps, a Risk versus Influence Matrix, Risk Summary, and Supplemental Risk Treatment Plan.

Table 4-1 Description of Risk Evaluation Tools

Tool	Description
• Risk Map	• Provides a visualization tool to illustrate the project risk profile and the changes to that profile if risks and opportunities are properly managed (see Appendix 10.5 Sample Risk Map).
• Risk versus Influence Matrix	• Shows which risks have the highest ability to be influenced by the risk treatment relative to their risk level; as such, those risks should be prioritized for treatment (see Appendix 10.6 Sample Risk Influence Matrix).
• Risk Summary	• Lists all evaluated risks with their rank and severity level before and after treatment (see Appendix 10.7 Sample Risk Summary).
• Risk Treatment Plan	• Identifies mitigation measures to be implemented during the course of the project to reduce or eliminate the risk. It also identifies a risk owner who is responsible for managing the mitigation strategy.

For less complex projects, the project team uses a Simplified Risk Assessment Form (See Appendix 10.2 Simplified Risk Assessment Form and Appendix 10.3 Simplified Risk Assessment Form - Risk Impact Summary).

5 RISK ANALYSIS AND MITIGATION

Risk analysis and evaluation includes methods for qualitative and quantitative risk assessment of both cost and schedule. As the project develops and cost and schedule are further defined, the risk analysis becomes more accurate. Risks can be associated with specific tasks and critical path risks can be identified. The mitigation strategies identified in the risk mitigation plan for critical path risks should be prioritized.

Table 5-1 Methods for Qualitative and Quantitative Risk Analysis

Analysis	Method
• Qualitative Risk Analysis helps prioritize the identified risks for further action	• Focus on high-priority risks can help improve the project's performance
• Quantitative Risk Analysis estimates the probability of meeting project objectives	• Risk Impact Summary is a tool used for smaller, less complex projects • Monte Carlo simulation is most widely used statistical technique

5.1 Risk Response

Risk Response planning helps to develop options and determine actions to enhance opportunities and reduce threats to the project objectives. High-risk uncertainties evaluated in the qualitative and quantitative risk analysis take priority over other risks.

Table 5-2 Strategies for Risk Response

Risk	Response
• Negative Risks or Threats	• Avoid o Seek strategies to avoid or eliminate uncertainty. Some risks can be avoided by clarifying requirements, improving communication, or acquiring expertise. • Transfer o Shift the negative impact of the risk to a third party. Transferring risk ownership or liability to a third party does not eliminate the potential exposure. • Mitigate o Modify the degree of risk exposure. Reduce the likelihood or consequence (or both) of an adverse risk to an acceptable threshold. Proactive approach will yield better results.
• Positive Risks or Opportunities	• Exploit o Take action to ensure that the opportunity happens. Maximize the probability by leveraging unexpected positive effects. • Share o Apportion ownership of the risk between the Port and a third party who is best able to capture the opportunity for the benefit of the project. • Enhance o Increase the probability and positive impacts of the opportunity. Identify key drivers and maximize the benefit to the project.
• Both Threats and Opportunities	• Accept o Risks may occur regardless of action taken to avoid or mitigate them. These risks are usually accepted and accounted for in the project scope, schedule and budget through the contingency. Accepted risks should continue to be monitored.

5.2 Risk Treatment

All levels of risk assessment are required to identify the following response to each risk:

Table 5-3 Risk Responses

Risk	Response
• Risk Treatment Plan	• Defines how the risk will be managed
• Responsible Person	• Identifies the risk owner responsible for managing and tracking the risk mitigation through implementation
• Due Date	• Specifies the deadline when the risk must be treated or followed-up
• Action Progress Status	• Is an on-going status report
• Total Cost to Action	• Determines the costs to implement the treatment to manage the risks

5.3 Quantitative Risk Assessment

Quantitative risk assessment tools, such as Monte Carlo simulation, are used to understand the impact of risk and uncertainty on project factors such as cost and schedule. Monte Carlo simulation incorporates random variables and probability to model different outcomes. By applying statistical probability to identified risks, the results of the simulation identify a range of possible outcomes and the probability each outcome will occur. By quantifying possible outcomes, decision-makers are able to better understand and plan for potential risks.

The risks with their attributes generated in the risk register are used to develop a Monte Carlo simulation. Cost consequences and schedule delays for each risk and likelihood of risk occurrences are used as the basis for the analysis. The cost of risk treatment should also be considered in the quantitative analysis. Otherwise, it may adversely impact contingency estimates.

Once the model is developed, the simulation can be "run" for a designated number of iterations. The more iterations that the model runs, the more possible combinations of results are produced. POLB typically runs each project scenario using a thousand iterations. The increased number of combinations of possibilities and severities within the simulation reduces the impact of remote outliers and provides an indication of the risks which are more likely to impact a project.

Decision-makers have differing ranges of risk that they are willing to accept. POLB typically looks at the Monte Carlo simulation results at three different levels of certainty, which are represented by the 50th centile, 70th centile, and 90th centile values of non-exceedance.

Another form for simulating risk results is the Risk Impact Summary. This methodology is utilized for smaller and less complex projects. The Impact Summary is directly linked to the Abbreviated Risk Register, which is also used for such projects.

Table 5-4 Delivery per Project Phase

Levels of Certainty	Context
• 50th centile	• Represents the mean value or "average" outcome of all simulation runs. • This approach would typically be run for a decision-maker that wanted to have a general idea of the likely cost and schedule impacts.
• 70th centile	• Indicates the point at which 70% of the simulation runs result in values that will not exceed the 70th centile value. • The 70th centile is a more conservative approach than using the mean value. • Identifies the value at which the decision-makers can be confident that there is a 70% chance that the outcome will not exceed the value identified.
• 90th centile	• Represents results on the extreme high end of the possible outcomes. • This approach to planning for uncertainties allows the decision-makers to be assured that it is highly unlikely that the actual results will exceed the values used in their planning models.

Example of results from a simulation is included in Appendix 10.9 Sample Monte Carlo Simulation Results.

6 RISK MONITORING AND CONTROL

Project risks must be proactively managed. Although mitigations are in-place, they still may not be effective or significantly reduce the risk to acceptable levels. The risk management process systematically applies management policies, procedures, and practices to a set of activities intended to establish the context, communicate with stakeholders, as well as analyze, treat, and monitor risks. Systematic, timely, and tailored risk management leads to greater predictability and improvement of the project outcomes.

6.1 Ongoing Risk Assessment and Management

Identifying and assessing risks are only the first steps in using the RAAM process as an effective project management tool. Risk management entails creating a mitigation plan, specifying timelines within the project delivery process for updating the risk register and using the risk assessment tools for making decisions.

The ongoing risk assessment and management are critical to the overall RAAM process. Both the risk register and the risk treatment progress must be regularly monitored, updated, and managed. Risks should be managed in a continuous feedback loop. Managing risks requires complying with the risk treatment plan, tracking risk reduction over time, and providing regular updates and continuous improvement. The continuous improvement process involves continual education, communication, and the implementation of the lessons learned.

Certain project risks can be classified by the project team as a tracking risk to be aware of, but are not quantified nor included in the simulation. The tracking risk is a risk that may escalate to a higher risk rating as the project progresses, but initially is just on the project team's radar to be aware of and track. The risk-based approach and advanced tools not only help track these risks, but also reduce their quantity and their potential impact to the project.

7 ROLES AND RESPONSIBILITIES

Project managers and their teams shall adhere to the provisions of the RAAM process described in this manual, but in cases where it is impractical or otherwise impossible, they are to work with the appropriate POLB staff to develop an alternate approach.

7.1 Accountability

Successful project delivery does not prevail without accountability. Accountability allows the project team members to recognize reality, become aware of failures, and develop and maintain a sense of ownership of and responsibility for the project risk. The Project Manager manages multiple project activities and should assign the risk owners for specific risks for the benefit of the overall project delivery process. Individuals should take responsibility for each risk response to ensure the appropriate risk monitoring. However, someone else may be assigned to implement the risk treatment. The Project Manager and the project team determine the best strategy for each risk and then formulate specific actions to implement that strategy.

Table 7-1 Roles & Responsibilities

Roles	Roles & Responsibilities
• Project Manager	• Accountable for the overall implementation and execution of the project risk assessment and management. • Identify stakeholders, resources, and time needed for the project risk management. • Coordinate and facilitate workshops, with assistance of external consultant, as needed. • With the assistance of the project team, develop and update the risk register, incorporate it into the work plan, and monitor and implement the risk treatment plan. • Maintain proficiency in risk assessment and tools through continuing education.
• Project Team	• Identify project risks and develop complete descriptions. • Assess the likelihood and consequence of each risk, including the impact of risks on project cost (hard and labor) and schedule. • Help identify the risk owners and assist in developing the risk treatment strategies (project team members may be assigned as risk owners). • Perform the assigned risk treatments and assist in risk monitoring and control.

Roles	Roles & Responsibilities
• Risk Coordinator	• Serve as a resource on risk assessment process, coordinate updates to the RAAM manual, and maintain the Risk Inventory database. • Provide ongoing guidance and training to Project Managers on risk assessment techniques. • Assist Project Manager with planning and scheduling workshops and updating and managing the risk register. • Coordinate third party facilitation, as required, and manage risk consultant contracts.
• Risk Owner	• Develop and implement the assigned risk treatment strategy and provide updates to the Project Manager. • Monitor the allocated risks and inform the Project Manager of any threats or opportunities to the project, including triggers and the events when risks become real.
• Division Director (or designee)	• Ensure the project risk management policy is created and executed. • Review the plans and progress at key milestones.

7.2 Reporting

Reporting keeps stakeholders informed of the progress and critical aspects of the project. The risk assessment team develops reports typically after each workshop. The reports are critical to the project team for risk mitigation monitoring and become key elements of discussion to ensure that risk impacts and mitigations are being addressed by the risk owner as project advance.

8 LESSONS LEARNED

The staff at the Port of Long Beach recognizes the need to learn from its experiences, identify successes and challenges on projects, and leverage that experience to improve the delivery of projects.

The documentation of lessons learned are the responsibility of the project manager. The documentation shall be performed throughout the delivery process and accumulated at the close-out phase. The value of having a repository of lessons learned from past projects allows future project managers with a similar project a basis to develop a risk assessment that reflects the risk impacts and opportunities that may arise during each of the project delivery phases.

9 DEFINITIONS

Risk is an uncertain event or condition that, if it occurs, has a negative or positive effect on at least one project objective. A risk may have one or more causes and, if it occurs, one or more impacts. A risk is measured in terms of the consequences of an event and the likelihood of its occurrence.

Threat is a risk that will have a negative impact on a project objective if it occurs (what might happen to jeopardize the project's ability to achieve its objectives).

Opportunity is a risk that will have a positive impact on a project objective if it occurs (what might happen to improve the project's ability to achieve its objectives).

Triggers are causes, symptoms and warning signs that indicate whether a risk is becoming a near-certain event and a contingency plan or response plan should be implemented.

Residual risk is a risk that remains even after developing responses to the project's original risks.

Secondary risks are caused by responses to the project's original risks.

Risk interaction happens when the combined effect of two or more risks occurring simultaneously is greater than the sum of the individual effects of each free-standing risk.

Risk management is the systematic process of planning for, identifying, analyzing, responding to, and monitoring project risks from project initiation through close-out.

Risk assessment is the qualitative process of gathering stakeholder input, identifying project risks, and developing a customized risk assessment plan.

Risk owner is the person/organization responsible for managing risk.

Risk planning is the initial phase in the risk assessment process.

Risk workshop is a formal meeting with the risk assessment team to identify and analyze specific risks related to a project. This may include an initial and follow-up workshop(s).

Risk register is a tool which represents the identification and analysis of project risks.

Risk treatment plan is a plan of action to manage, mitigate, and track the identified risks.

Supplemental risk treatment plan is a management tool used on some risks already identified in the risk register to provide further detailed development of the specific mitigation plan.

Risk management plan is composed of the risk register and related risk treatment plans.

Risk watch list includes the risks that have been identified as low and medium risk on the risk register that need to be reviewed throughout the length of the project and updated as necessary.

Hard costs are directly related to the project. They are tangible, relatively easy to determine, and include items such as direct labor, direct cost and material, and other pre- and post-construction expenses.

Labor costs are indirectly related to the project. They may include indirect labor provided by POLB staff, POLB consultants, insurance, taxes, legal fees, and other expenses.

Existing controls identify any existing policies and procedures that could be used to control the risk event and/or prevent it from occurring.

Risk database is an on-going list of common risks identified on POLB projects to be used during each risk assessment. The risk database is also to be updated with each project.

Monte Carlo Simulation is a statistical modeling simulation of both cost and schedule risks.

Risk Impact Summary is an approach for simulating risk typically used for smaller and less complex projects.

10 APPENDICES

10.1 Risk Brainstorming Prompt List

10.2 Simplified Risk Assessment Form

10.3 Simplified Risk Assessment Form - Risk Impact Summary

10.4 Sample Risk Register

10.5 Sample Risk Map

10.6 Sample Risk Influence Matrix

10.7 Sample Risk Summary

10.8 Sample Likelihood and Consequence Table

10.9 Sample Monte Carlo Simulation Result and Tornado Graph

Appendix 10.1 Risk (Threat & Opportunity) Brainstorming Prompt List

This Risk Brainstorming Prompt List is intended to help in identification of threats and opportunities. It is not exhaustive and should be review

Contract

Arbitration
Completion Requirements
Confidentiality
Consequential Damages
Contractors
Design Liabilities
Force Majeure
Funding Guarantees
Insurance
Intellectual Property
Interaction
Contract Language
Legal Jurisdiction
Liquidity Liabilities
Payment Currency
Payment Terms
Penalties
Performance Provisions
Acceptance Provisions
Scope and Completeness
Termination
Terms and Conditions
Variations/Claims

Customer

Cancellation
Contractors
Culture/Attitude
Design Standards
Experience Funding
HSE Management
Interface Involvement
Language Litigation
Ownership Process
Program Relationship
Repudiation Site/Location
Solvency/Stability

Design Engineering

Abatement Technologies
Assumptions
Authorization/Acceptance
Accountability
Basis of Design
Change Management
Engineering/Verification
Communication
Complexity
Contractors Cost
Estimates
Design Deliverables
Change Document
Data Management
Emerging Technology
Design Systems
Innovation Interfaces
Limitations
Maintainability
Materials Optimization
Organization and Control
Quality
Third Party Reliability
Research and
Development Review
Scope Specification
Sustainability
Value Engineering

Procurement

Confidentiality
Contractors Delays
Evaluation
Expediting
Export Restrictions
Inspection
Logistics
Materials Control Quality
Control Strategy
Vendor/Supplies

Environmental

Air Quality
Biodiversity/Marine Quality
Special Status Species
Emissions/Discharges
Fire/Flood/Drought
Land Contamination
Land Use
Landslide/Mudslide
Liquid Wastes
Solid Wastes
Natural Disasters
Preservation
Reclamation
Remediation
Climate Change Adaptation
Severe Weather
Surface/Ground Water
Watershed Protection
Wetland Mitigation

Site/Construction

Access Accommodation
Change Control Conflict
Delays
Emergency/Evacuation
Equipment/Tooling
Facilities
Ground/Weather
Conditions Industrial
Relations
Inspection/Testing
Interaction / Interfaces
Labor
Logistics Methods Medical
Modifications
Organization and Control
Plant
Productivity Program
Relocation
Responsibility Control
Restrictions
Safety Utilities
Working Conditions

Quality

Assurance
Schedule/Program
Certification
Compliance
Competency
Qualification/Training
Criticality
Continuous Improvement
Process Controls
Corrective Action
Customer Feedback
Customer Complaints
Document Management
Document Changes
Inspection Review
Testing Quality Review
Records Management
Records Review
Preventative Action
Standards
System Compliance
Tolerances/Calibration

Project Management

Adequacy/Suitability
Baseline Communication
Compression
Contingency
Critical Flexibility
Interface/Interaction
Lessons Learned Loading
Mobilization Program

Regulations/Permitting

Approvals
Chemical
Credits
Environmental Legislation
Licenses
Noise
Health and Safety Permits
Reporting Requirements

Human Resources

Availability
Commitment
Conditions
Contractors
Corporate Memory
Culture
Development
Excess
Experience
Industrial Relations
Leadership
Location/Mobility
Occupational Health and Safety
Retention
Satisfaction/Morale
Skills
Stability/Continuity
Succession
Training

Finance

Cash flow
Cost Management
Foreign Exchange (FX)
Funding
Information
Invoicing
Liquidity
Non-Billable
Revenue/Profits
Repatriation
Taxation
Transparency

Systems

Adequacy
Failure/Lack of
Information Security
Knowledge Management
Overload
Support
Systems Rollout
Training/Competency
Work Practices

Health and Safety

Conflict
Crime
Field Work
Health and Wellness
Induction
Medical Assistance
Overwork/Stress
Remote Location
Safety
Security Site Activity

Political

Civil Disorder
Economic Stability
Instability
Inflation
Pressure Groups
Racial/Religious Conflict
Sanctions
Terrorism
Labor Unions

Community

Archaeology and Cultural Heritage
Conflict, Security and Crime
Cultural Identity
Health Impacts
Livelihood
Local Communities
Noise
Public Perception
Recreational Use
Resettlement
Visual Impacts

Operations

Acceptance/Testing
Authorizations
Availability/Reliability
Commissioning
Decommissioning
Costs
Operability
Performance
Start-Up
Throughput
Training
Security
Supervision
Transport

Delivery Model

Compromise
Differentiators
Economies of Scale
Fast Track
Inefficiency
Innovation
Leverage
Market Gap
Emerging Markets
Mobilization
Rework
Support
Uncompetitive
Work share

Location/Office

Assets/Equipment
Business Continuity Planning
Crisis and Emergency Management
Demobilization
Expansion
Infrastructure
Office Space
Overheads
Performance
Reputation

Appendix 10.2 Simplified Risk Assessment Form

Risk Number	Risk Description	Before Treatment			Risk Treatment Description	Treatment Cost	After Treatment			Responsible Party/Due Date	Notes
		Est. Risk Consequence - $	Est. Risk Consequence - Schedule (days)	Likelihood			Est. Risk Consequence After Treatment - $	Est. Risk Consequence After Treatment - Schedule	Likelihood		
1	Hazardous materials	$ 150.00	30	Likely	Sample soil during design	$ 10.00	$ 76.00	15	Rare		
2	Permits	$ 45.00	180	Likely	Verify approvals	$ -	$ 23.00	30	Moderate		
3	Geotechnical/environmental conditions	$ 20.00	90	Almost Certain	Potholing	$ 5.00	$ 17.00	60	Likely		
4	Utility Conflicts	$ 10.00	30	Likely	Obtain utility plans	$ 8.00	$ 9.00	10	Moderate		
5	Coordination with tenants	$ 15.00	90	Likely	Coordination with tenant - accepted risk		$ 15.00	30	Likely		Accepted risk
6	Traffic management	$ 5.00	5	Moderate	None		$ 5.00	5	Moderate		Tracking - accepted risk

Disclaimer: The inclusion in reports and tracking systems of POLB risk estimates of likelihood and probability of cost, schedule or scope impacts, including but not limited to Estimate at Completion, Forecast Finish date, POLB Cost Estimate, POLB Time Estimate, Cost Issues, etc., does not indicate Port agreement as to entitlement or amount and is not to be construed as an admission for any purpose.

Note: Exempt from Disclosure Under the Public Record Act – Deliberative Process/G.C. § 6255

Likelihood		Range
5%	Rare	0% to 12.5%
20%	Unlikely	12.5 to 35%
50%	Moderate	35% to 65%
80%	Likely	65% to 87.5%
95%	Almost Certain	87.5% to 100%

Tracking

Appendix 10.3 Simplified Risk Assessment Form - Risk Impact Summary

Risk Number	Risk Description	Before Treatment Est. Risk Impact				After Treatment Est. Risk Impact				Treatment Cost
		Dollars		Schedule		Dollars		Schedule		
		Low	High	Low	High	Low	High	Low	High	
1	Hazardous materials	$ 97.50	$ 131.25	19.5	26.3	$ -	$ 9.50	-	1.9	$ 10.00
2	Permits	$ 29.25	$ 39.38	117.0	157.5	$ 8.05	$ 14.95	10.5	19.5	$ -
3	Geotechnical/environmental conditions	$ 17.50	$ 20.00	78.8	90.0	$ 11.05	$ 14.88	39.0	52.5	$ 5.00
4	Utility Conflicts	$ 6.50	$ 8.75	19.5	26.3	$ 3.15	$ 5.85	3.5	6.5	$ 8.00
5	Coordination with tenants	$ 9.75	$ 13.13	58.5	78.8	$ 9.75	$ 13.13	19.5	26.3	$ -
6	Traffic management	$ 1.75	$ 3.25	1.8	3.3	$ 1.75	$ 3.25	1.8	3.3	$ -
	Total	$ 162.25	$ 215.75	$ 295.00	$ 382.00	$ 33.75	$ 61.55	$ 74.25	$ 109.88	$ 23.00

Disclaimer: The inclusion in reports and tracking systems of POLB risk estimates of likelihood and probability of cost, schedule or scope impacts, including but not limited to Estimate at Completion, Forecast Finish date, POLB Cost Estimate, POLB Time Estimate, Cost Issues, etc., does not indicate Port agreement as to entitlement or amount and is not to be construed as an admission for any purpose.

Schedule delay is a surrogate measure of delay in that it is a summation of all risk-driven delays with no reference to whether the risks or treatments are concurrent or not. A detailed schedule analysis would be required to determine the "net"

Delay outcome for this portfolio of risks, which can provide adjustment for any concurrencies. Such an analysis is not a part of this study's scope. Therefore, the gross calendar day delay total referenced herein should be viewed as a conservative measure to gauge gross aggregate potential of delays resulting from these risks, not a net delay to the project.

The risk contingency cost estimate should not be considered a substitute to the ordinary project contingency amount. The risk analysis that forms the basis of this study addresses specific risks of a certain magnitude or larger. Historic data shows there are many small size impacts on a project that can lead to meaningful aggregate additional costs during an infrastructure program delivery, even though these items may not necessarily exceed the cost magnitude threshold designated for

Likelihood		Range
5%	Rare	0% to 12.5%
20%	Unlikely	12.5 to 35%
50%	Moderate	35% to 65%
80%	Likely	65% to 87.5%
95%	Almost Certain	87.5% to 100%

Appendix 10.4 Sample Risk Register

Column Key:

	Do not enter data - automatically generated field
	Drop down list, select one item from list
	Enter text in this column

Number	Rank	Initiator	Risk Type	Risk Description	Risk Consequence (including schedule/cost impacts)			Category	Phase	Existing Controls	Risk Severity Before Treatment				
					Hard Costs Impacts ($ in thousands)	Soft Costs Impacts ($ in thousands)	Schedule Impacts (days)					Consequence		Likelihood	Risk Level Before
1	2		PR	Foreseen underground obstructions	500	15	45	Engineering / Design	Construction	Keep a utility coordinator on board during constructability reviews and construction.	5	Catastrophic	C	Moderate	Extreme
2	1		PR	Unforeseen oil related issues, including contamination, utilities and oil wells	300	8	180	Contamination	Construction	Maintain communication with regulatory agencies responsible for oversight of remediation.	4	Major	B	Likely	Extreme
3	4		PR	Delays in environmental and regulatory permits	150	30	30	Environmental / Regulatory Compliance	All	1. Lessons learned incorporated. 2. Coordinate with agencies, identify key regulatory contacts.	3	Moderate	B	Likely	High
4	5		PR	Adjacent projects may impact work and schedule	199	30	10	Third Parties / Stakeholders	Construction	Coordinate with other PMs	2	Minor	E	Rare	Low
5	3		PR	Miscellaneous terminal improvements required by the tenant during construction	49	20	3	Tenant	Construction	Perform ongoing coordination and scope meetings with the tenant.	1	Insignificant	A	Almost Certain	High

Risk Treatment Plan	Ability to Influence	Action Plan Type	Risk Consequence (including schedule/cost impacts)			Risk Severity After Treatment					Responsible Person & Organization	Due Date	Action Progress Status	Risk Status	Cost of Treatment
			Hard Costs Impacts ($ in thousands)	Soft Costs Impacts ($ in thousands)	Schedule Impacts (days)		Consequence		Likelihood	Risk Level After					($ in thousands)
Use physical site assessment data to identify areas of potential obstructions	Moderate	Reduce Consequence	199	5	15	2	Minor	C	Moderate	Moderate				In Progress	22
1. Perform additional substructure investigation and conduct additional testing. 2. Consider use of in-situ risk management to minimize excavation resulting in overall cost reductions. This is a potential opportunity.	Moderate	Reduce Likelihood	300	8	180	4	Major	E	Rare	High			This risk will be monitored throughout the project.	Ongoing throughout project	5
1. Complete permitting review in advance, lead time for permits and/or associated items, key regulatory contacts. 2. Retain third party to oversee and complete permitting, independent of the project. 3. Incorporate sufficient time in schedule to account for permit conditions / requirements that could result in overall schedule delays.	Moderate	Reduce Likelihood and Consequence	100	10	30	2	Minor	D	Unlikely	Low				Not Commenced	32
None	High	Avoid / Eliminate	0	0	0	1	Insignificant	E	Rare	Low				No longer applicable	
Schedule coordination meeting with the tenant to review other potential improvements and schedule issues.	Low / None	Accept	49	20	3	1	Insignificant	A	Almost Certain	High				Implemented	

Appendix 10.5 Sample Risk Map

Risk Map
Before Treatment

Likelihood			Consequence				
			Insignificant	Minor	Moderate	Major	Catastrophic
			1	2	3	4	5
Likelihood	A	Almost Certain			20	19	
	B	Likely		6 14	3 30	21	
	C	Moderate		9 10 11 22	5 27 29	1 2 13 25 26 28	17
	D	Unlikely		7 8	15 18		
	E	Rare	24	12	16 23	4	

Risk Map
After Treatment

Likelihood			Consequence				
			Insignificant	Minor	Moderate	Major	Catastrophic
			1	2	3	4	5
Likelihood	A	Almost Certain			20	19	
	B	Likely		14	30	21	
	C	Moderate		6 9 11 22 27	25 26 29	13 28	
	D	Unlikely		7 8 10 15	3 17 18	1 2	
	E	Rare	24	5 12 16	23	4	

Appendix 10.6 Risk vs. Influence Matrix

		Ability to Influence		
		Low / None	Moderate	High
Risk	Extreme	13 19 20 21 28		
	High	14 29	1 2 4 30	
	Moderate	9 11 18 22 23	6 27	
	Low	7 8 12 24	10 15 16	

Appendix 10.7 Sample Risk Summary

Number	Rank	Risk Description	Risk Level Before Treatment	Risk Level After Treatment
1	2	Foreseen underground obstructions	*Extreme*	*Moderate*
2	1	Unforeseen oil related issues, including contamination, utilities and oil wells	*Extreme*	*High*
3	4	Delays in environmental and regulatory permits	*High*	*Low*
4	5	Adjacent projects may impact work and schedule	*Low*	*Low*
5	3	Miscellaneous terminal improvements required by the tenant during construction	*High*	*High*

Appendix 10.8 Sample Likelihood and Consequence Table

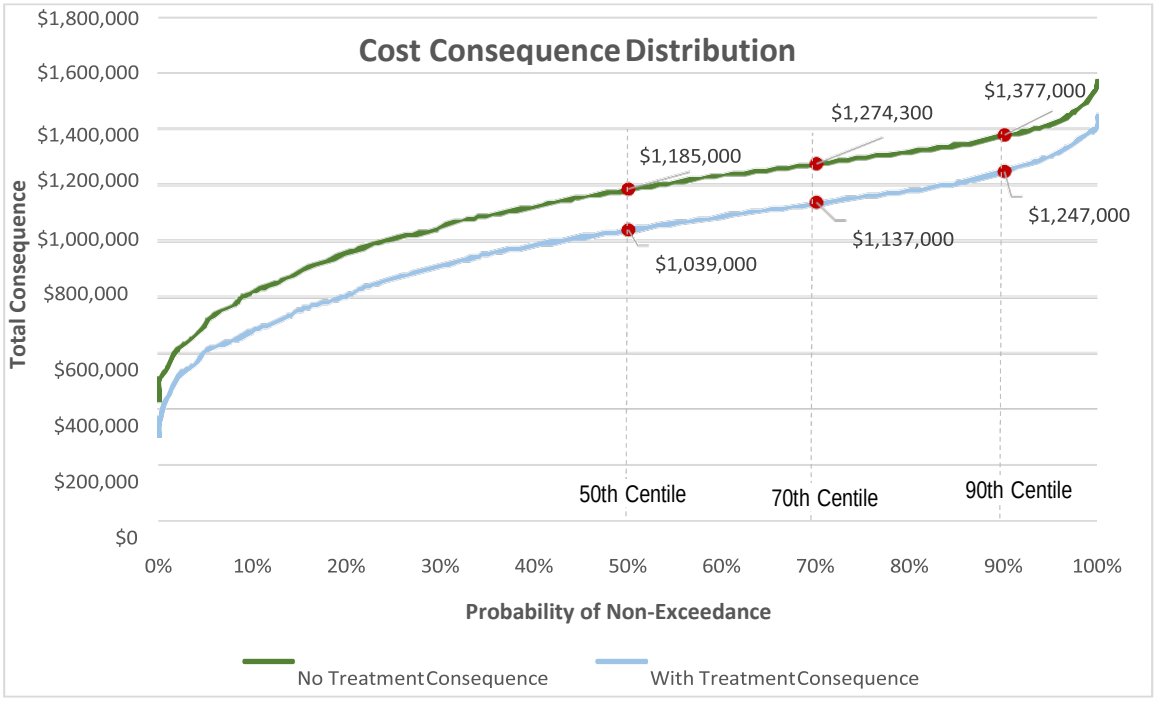
Project teams are advised to review the categories and adjust the scale relevant to their project. All fields should be reviewed and amended before the workshop or risk register update meeting.

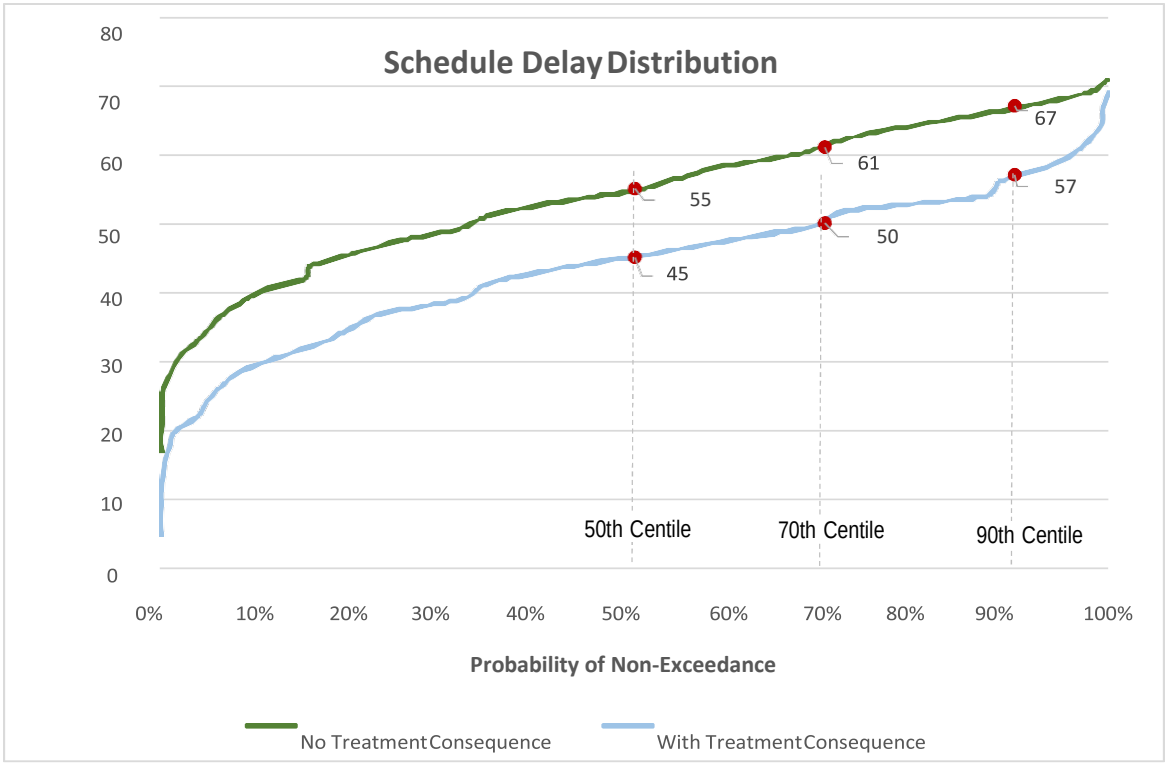
Likelihood				
E	D	C	B	A
Rare	Unlikely	Moderate	Likely	Almost Certain
Highly unlikely to occur on this project	Given current practices and procedures, this incident is unlikely to occur on this project	Incident has occurred on a similar project	Incident is likely to occur on this project	Incident is very likely to occur on this project, possibly several times
OR				
5% chance of occurring	20% chance of occurring	50% chance of occurring	80% chance of occurring	95% chance of occurring

	Consequence				
	1 - Insignificant	2 - Minor	3 - Moderate	4 - Major	5 - Catastrophic
Safety and Health	First Aid Case	Minor Injury, Medical Treatment Case with/or Restricted Work Case	Serious injury or Lost Work Case	Major or Multiple Injuries permanent injury or disability	Single or Multiple Fatalities
Environment	No impact on baseline Environment. Localized to point source. No recovery required	Localized within site boundaries. Recovery measurable within 1 month of impact	Moderate harm with possible wider effect. Recovery in 1 year	Significant harm with local effect. Recovery longer than 1 year.	Significant harm with widespread effect. Recovery longer than 1 year. Limited prospect of full recovery
Financial	< $49K	$50K - $199K	$200K - $999K	$1M - $5M	> $5M
Schedule	< 3 days	3 days - 29 days	30 days - 89 days	3 - 6 months	> 6 months
Reputation	Localized temporary impact	Localized, short term impact	Localized, long term impact but manageable	Localized, long term impact with unmanageable outcomes	Long term regional impact
Business Impact	Impact can be absorbed through normal activity	An adverse event which can be absorbed with some management effort	A serious event which requires additional management effort	A critical event which requires extraordinary management effort	Disaster with potential to lead to collapse of the project

Appendix 10.9 Sample Monte Carlo Simulation Results and Tornado Graph

Cost Consequence and Schedule Delay Distributions





Tornado Graph Distribution – Sample