Washington State
Department of Transportation

Project Risk Management

Guidance for WSDOT Projects

October 2013

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Foreword

"What gets us in trouble is not what we don't know. It's what we know for sure that just ain't so." *Mark Twain*

Inaccurate cost estimating has dogged transportation projects for years. B. Flyvbjerg's noted study on the results of transportation project estimating found that for the past 70 years, the cost of transportation projects has been consistently underestimated in many parts of the world, including the U.S.

The future is uncertain, but it is certain that there are two questions will be asked about our projects: (1) How much will it cost? (2) How long will it take? And of course the obvious follow-up question: Why? (Why that much and why that long?)

These questions are posed in the future tense, and we are being asked to predict an uncertain future. Because the future is uncertain the fundamental answers to these questions is that an estimate is more accurately expressed not as a single number but as a range. To determine an accurate estimate range for both cost and schedule, risk and uncertainty must be quantified.

Estimates are comprised of two components: the base cost component and the risk (or uncertainty) component. Base cost is defined as the likely cost of the planned project if no significant problems occur. Once the base cost is established, a list of uncertainties is created of both opportunities and threats, called a "risk register." The risk assessment replaces general and vaguely defined contingency with explicitly defined risk events and with the probability of occurrence and the consequences of each potential risk event. Scope control is of course necessary for project management and estimating. Cost estimates are to be reviewed and validated, and a base cost for the project is determined.

Project risk management is a scalable activity and should be commensurate with the size and complexity of the project under consideration. Simpler projects may utilize simple qualitative analysis as found in the Project Management Online Guide in the Risk Management Plan spreadsheet. Larger more complex projects may wish to use more robust analysis techniques via Monte-Carlo simulation models.

This guidance has been developed by the Strategic Assessment and Estimating Office (SAEO) in alignment with the goals of the Statewide Program Management Group (SPMG). This document would not have been possible with the contributions of dozens of key WSDOT people who participated in the development and review of these guidelines.

DRAFT

FirstName LastName
WSDOT State Design Engineer

Comment Form

NOTE: This document is a working draft – your feedback and input is greatly appreciate.

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Subject: Project Risk Management Guide Comment

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Contents

Purpose

This document provides information to project managers and project teams that will help with their risk management efforts in the following ways:

- Provide a consistent methodology for performing project risk management activities.*
- Provide techniques and tools for project risk management.
- Identify data requirements for risk analysis input and for output (CPMS data requirements).
- Provide information on how project risk management fits into the overall project management process at WSDOT.
- Provide guidance on how to proactively respond to risks.

Understanding of project risks will better enable project teams to contribute to the fulfillment of public service through assessing project risk and uncertainty to aide in making decisions regarding project development and delivery. These decisions contribute to public safety and the projects we deliver add value to Washington State on many levels.

Estimating the cost of transportation projects is a fundamental responsibility of the Washington State Department of Transportation (WSDOT). In recognition of the fundamental and strategic importance of cost estimating these guidelines provide consistent practices across the agency to enhance methods for meeting this responsibility. These guidelines were developed by the Strategic Analysis and Estimating Office with contributions from a number of specialists in cost estimating and project development.

Estimators must be shielded from pressures to prepare estimates that match some preconceived notion of what a project should cost. Estimators need to prepare estimates based on the scope of the project, the schedule of the project and the bidding conditions that are anticipated.

"No construction project is risk free. Risk can be managed, minimized, shared, transferred, or accepted. It cannot be ignored."
Sir Michael Latham, 1994

* The methodology is consistent with the Project Management Institute (PMI) per the Project Management Body Of Knowledge (PMBOK).

Definitions of Selected Terms

Base Cost Estimate – The Base Cost represents the cost which can reasonably be expected if the project materializes as planned. The base cost estimate is ubbiased and neutral- it is not optimistic and it is not conservative. The base cost estimate includes the standard WSDOT 4% construction contingency described in the *Plans Preparation Manual* M 22-31. It dose not include any significant risks (threats or opportunities).

Note:

1. refer to WSDOT *Plans Preparation Manual* M 22-31 Section 800.03(2)

   "Contingency percentages' are setup to handle unforeseen changes in a project during construction, including additional work, quantity over-runs, and additional items. Contingencies are currently limited to 4% of the total contract amount for all WSDOT contracts."

2. The Base Cost typically falls in the 20% to 40% confidence level in the Risk Based.

Construction Phase (CN) – The activities associated with the administration of a contract for specified services and physical infrastructure. Primarily, the construction phase includes change management, assurance that safety and associated impacts to the traveling public are mitigated, payment for work completed, and the documentation of physically constructed elements, certification and documentation of quality.

Estimator – "One who assesses the extent of work and/or components of the work (i.e. materials, equipment and labor) to be done to complete a project, or a strictly defined part of the project, and state a likely or approximate quantity in generally accepted units of measurement and cost for the project."

Preliminary Engineering Phase (PE) – The effort (budget/cost) of taking a project through the planning, scoping, and design phases. Planning and scoping typically have separate budgets but are encompassed under Preliminary Engineering. The terms "Design" or "Design Phase" are sometimes used interchangeably with PE.

Project Cost Estimate – total project cost estimate includes PE + RW + CN

Right-Of-Way Phase (R/W) – This effort includes the revision of existing plans or the preparation of new plans detailing the need for new Right of Way defined during the design phase. It also includes the appraisal, negotiation, and purchase of new Right of Way by the Real Estate Services office. The right-of-way phase can begin during scoping, after design completion, or anytime in between. The phase end is when the RW is certified, but this may not have a direct relationship to the construction phase, except that CN cannot begin unless the RW is certified. Except under rare circumstances, all new Right-of-Way must be acquired before the project can go to Ad.

Note: Preparation of R/W Plans is paid for with PE dollars and is part of the design effort; Negotiation, Purchase and Acquisition of R/W is performed by the Real Estate Services office and comprises the cost of R/W.

Risk – The combination of the probability of an uncertain event and its consequences. A positive consequence presents an opportunity; a negative consequence poses a threat.

Risk Management –Refers to the culture, processes, and structures that are directed toward effective management of risks –including potential opportunities and threats to project objectives.

Risk-Based Estimate – Involves simple or complex modeling based on inferred and probabilistic relationships among cost, schedule, and events related to the project. It uses the historical data and/or cost based estimating techniques and the expert's best judgment to develop a Base Cost or the cost of the project if the project proceeds as planned. Risk elements (opportunities or threats) are then defined and applied to the Base Cost through modeling to provide a probable range for both project cost and schedule.

Strategic Analysis and Estimating Office (SAEO) – Part of the WSDOT Project Development Division, providing technical support in the disciplines of Project Risk Management , Project Risk Assessment, Estimating , Value Engineering, and Project development Support to WSDOT headquarters and regional offices. SAEO blends these areas of expertise to aid project offices in the effective delivery of construction projects and design. SAEO provides oversight , training, review, and scheduling assistance through a variety of workshops, studies, estimating tools, and project development courses. They also provide varying degrees of technical support to other state and local agencies. www.wsdot.wa.gov/Design/SAEO

A comprehensive glossary can be found at:
www.wsdot.wa.gov/Projects/ProjectMgmt/RiskAssessment/workshop.htm

The Value of Risk Management

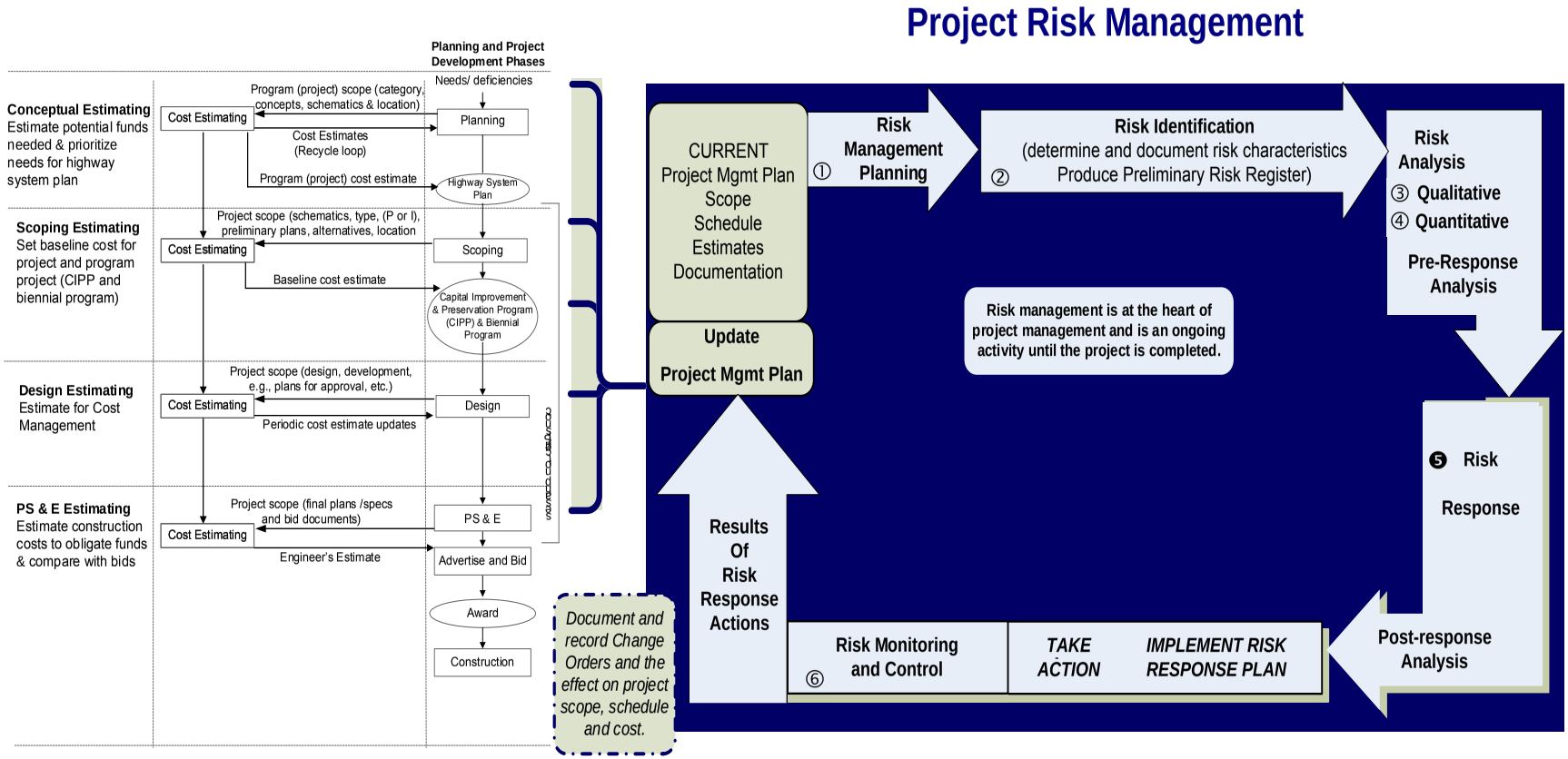
Project risk management delivers the following values:

- Contributes to project success;
- Recognizes uncertainty and provides forecasts of possible outcomes;
- Produces better business outcomes through more informed decision-making;
- Is a positive influence on creative thinking and innovation;
- Offers better control –less overhead and less time wasted, greater focus on benefits;
- Helps senior management to understand what is happening with the project and the challenges the project has to overcome.

Project risk management is an integral component of project management and found at the heart of WSDOT's Project Management processes. Risk management is also a key component of project cost estimating and scheduling, as noted in the National Cooperative Highway Research Program in NCHRP Report 574, which is available at the WSDOT library along with other publications on project management and risk management.

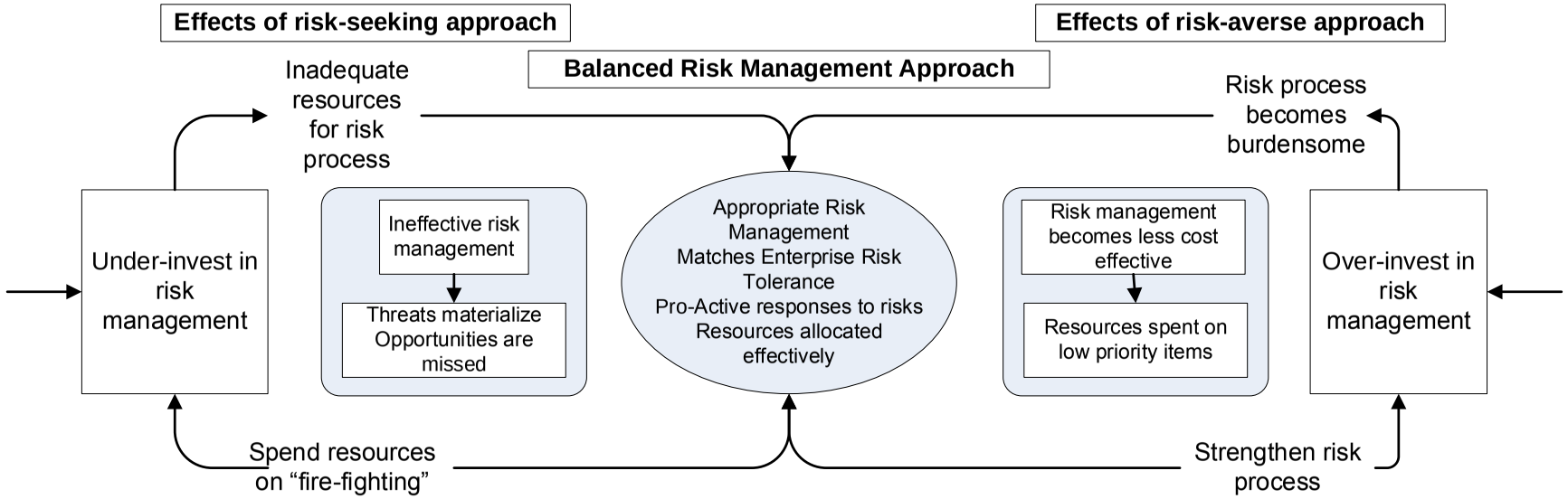
Figures 1 and 2, on the following pages, depict Project Risk Management through Project Development and Balanced Risk Management.

"The problem with the future is that more things might happen than will happen" (Plato). With effective risk management, as an integral and required part of project management, we can not only predict possible future outcomes, we can take action to shift the odds for project success in our favor.



Project Risk Management through Project Development and Construction

Figure 1



Credit: David Hillson

Balanced Risk Management (Risk Tolerance)
Figure 2

Risk management, as an integral part of project management, occurs on a daily basis. With pro-active risk management we look at projects in a comprehensive manner and assess *and document* risks and uncertainty. The steps for risk management are provided below.

Risk Management Steps

WSDOT Project Management Online Guide (PMOG) risk management steps:

1) Risk Management Planning	Risk Management Planning is the systematic process of deciding how to approach, plan, and execute risk management activities throughout the life of a project. It is intended to maximize the beneficial outcome of the opportunities and minimize or eliminate the consequences of adverse risk events. (WSDOT PMOG)
2) Identify Risk Events	Risk identification involves determining which risks might affect the project and documenting their characteristics. It may be a simple risk assessment organized by the project team, or an outcome of the CEVP®/CRA workshop process.
3) Qualitative Risk Analysis	Qualitative risk analysis assesses the impact and likelihood of the identified risks and develops prioritized lists of these risks for further analysis or direct mitigation. The team assesses each identified risk for its probability of occurrence and its impact on project objectives. Project teams may elicit assistance from subject matter experts or functional units to assess the risks in their respective fields.
4) Quantitative Risk Analysis	Quantitative risk analysis is a way of numerically estimating the probability that a project will meet its cost and time objectives. Quantitative analysis is based on a simultaneous evaluation of the impacts of all identified and quantified risks.
5) Risk Response Planning	Risk response strategy is the process of developing options and determining actions to enhance opportunities and reduce threats to the project's objectives. It identifies and assigns parties to take responsibility for each risk response. This process ensures that each risk requiring a response has an *"owner"* . The Project Manager and the project team identify which strategy is best for each risk, and then selects specific actions to implement that strategy.
6) Risk Monitoring & Control	Risk Monitoring and Control tracks identified risks, monitors residual risks, and identifies new risks—ensuring the execution of risk plans, and evaluating their effectiveness in reducing risk. Risk Monitoring and Control is an ongoing process for the life of the project.

The remainder of this document includes more detail on the steps listed above.

Table 1 provides a helpful comparison between risk and objectives for various types of risk management. For this document we are interested in *Project risk management*.

Type of risk management	**Description**	**Sample objectives**
Generic	Risk: any uncertainty that, if it occurs, would affect one or more *objectives*.	-
Project risk management	***Project Risk:* any uncertainty that, if it occurs, would affect one or more *project objectives***.	**Time, cost**, performance, quality, scope, client satisfaction.
Business risk management	*Business Risk:* any uncertainty that, if it occurs, would affect one or more *business objectives*.	Profitability, market share, competitiveness, Internal Rate of Return (IRR), reputation, repeat work, share price.
Safety risk management	*Safety Risk:* any uncertainty that, if it occurs, would affect one or more *safety objectives*.	Low accident rate, minimal lost days, reduced insurance premiums, regulatory compliance.
Technical risk management	*Technical Risk:* any uncertainty that, if it occurs, would affect one or more *technical objectives*.	Performance, functionality, reliability, maintainability.
Security risk management	*Technical Risk:* any uncertainty that, if it occurs, would affect one or more *security objectives*.	Information security, physical security, asset security, personnel security.
Credit: David Hillson, Effective Opportunity Management for Projects		

Relationship between Risk and Objectives
Table 1

Description

The power of risk management is fully realized when a project manager takes action to respond to identified risks based on the risk analysis, with effort being directed toward those risks that rank the highest in terms of significant impact to project objectives.

Inputs

Project scope, schedule, and estimate package. The estimate package should include the most current versions of the following items:

- Project Summary
- Detailed scope of work (commensurate to the level of development)
- Project Cost Estimate (with basis of cost estimate completed)
  - PE cost estimate
  - ROW cost estimate
  - Construction cost estimate
- Previous risk analyses (if applicable)
- Project Management Plan
- Project Schedule
  - Overall project schedule
  - Detailed construction schedule (commensurate to the level of development)
- QA/QC Status
- Additional information as necessary

Techniques and Tools

WSDOT provides a number of techniques and tools to assist in project risk management. These tools and techniques provide scalability and flexibility so that project teams can match the tool with the specific needs of their projects. Often times the appropriate tool is determined by the size and complexity of the project. These tools include:

- Project Management Online Guide (PMOG)
  - Project Management Plan (fundamental for all projects)
  - The PMOG provides a risk matrix for smaller simpler projects
  - Risk planning, risk assessment, and risk management are an integral element of project management

- Risk Management Plan spreadsheet template (found on SAEO website)
- Self-Modeling tool for quantitative risk analysis
- CRA workshops for all projects between $25M and $100M
- CEVP workshops for all projects over $100M

Output

CPMS data requirements per in Instructional Letter (IL) 4071.00; Project teams must provide specific data to the region program management office for inclusion into CPMS and the Transportation Executive Information System (TEIS). The required data is:

1. Project scheduling data for the following milestone dates:
    - Project definition completion date
    - Date for the beginning of preliminary engineering
    - Completion date for the environmental document
    - Start date for the acquisition of right of way
    - Date of right of way certification
    - Project advertisement date
    - Date project is operationally complete (substantially complete)
2. Estimated Project Cost Data (in Current Year Dollars, CY$)
    - Date of estimate basis (i.e., “2013 $”)
    - Design cost estimate
    - Right of way cost estimate
    - Construction cost estimate
3. Midpoint for construction phases using the project award date and the operationally complete date.

Project Risk Management and Risk Based Estimating

It is the policy of the Washington State Department of Transportation (WSDOT) to conduct risk based estimating workshops for all projects over $10 Million (PE, R/W and Const). These workshops provide information to project managers that can help them control scope, cost, schedule, and manage risks for all projects. This policy reaffirms the requirement that a **risk management plan** is a component of every project management plan.

Levels of risk based estimating, in support of risk management (E 1053.00):

Project Size ($)	**Required Process** (project managers can use a higher level process if desired)
Less than $10 M	Qualitative Spreadsheet in the Project Management Online Guide[1]
$10 M to $25 M	In-formal workshop using the Self-Modeling Spreadsheet[1, 3]
$25 M to $100 M	Cost Risk Assessment (CRA) Workshop[1, 2]
Greater than $100 M	Cost Estimate Validation Process (CEVP®) Workshop[2]

1 In some cases it is acceptable to combine the Value Engineering Study and Risk Based Estimating Workshop.

2 Projects $25 Million and over should use the self-modeling spreadsheet in the scoping phase risk based estimating process, followed up by the more formal CRA or CEVP® process during the design phase.

3 An informal workshop is comprised of the project team (or key project team members), other participants may be included as the project manager/project team deem necessary.

A general comparison of a few typical characteristics for CRA and CEVP®

	CRA	**CEVP®**
Workshop length	1 – 2 days	3 – 5 days
Subject Matter Experts	Internal and local.	Internal and external.
Timing (when to hold workshop)	Anytime. Typically updated when design changes or other changes to the project warrant an updated CRA.	Best to start early in the process, major projects are typically updated as needed.
General	An assessment of risks with an evaluation and update of costs and schedule estimates.	An intense workshop that provides an external validation of cost and schedule estimates and assesses risks.

Note: Workshops are orchestrated by the Cost Risk Estimating Management (CREM) unit of the Strategic Analysis and Estimating Office in HQ in collaboration with the project manager. The project manager submits a workshop request and works with the CREM unit to ascertain the type of workshop required and candidate participants. See WSDOT Guidelines for CRA-CEVP workshops for more details.

"It must be recognized that even the final construction estimate is of limited accuracy and that it bears little resemblance to the advance determination of the production costs of mass-produced goods. Construction estimating is a relatively crude process. The absence of any appreciable standardization together with a myriad of unique site and project conditions make the advance computation of exact construction expenditures a mater more of accident than design. Nevertheless, a skilled and experienced estimator, using cost accounting information gleaned from previous construction work of a similar nature, can do a credible job of predicting construction disbursements despite the project imponderables normally involved. The character of location of a construction project sometimes presents unique problems, but some basic principle for which there is precedent almost always apply."

Construction Project Management 5th Edition, Sears and Clough 2008

Chapter 1 Risk Management Planning

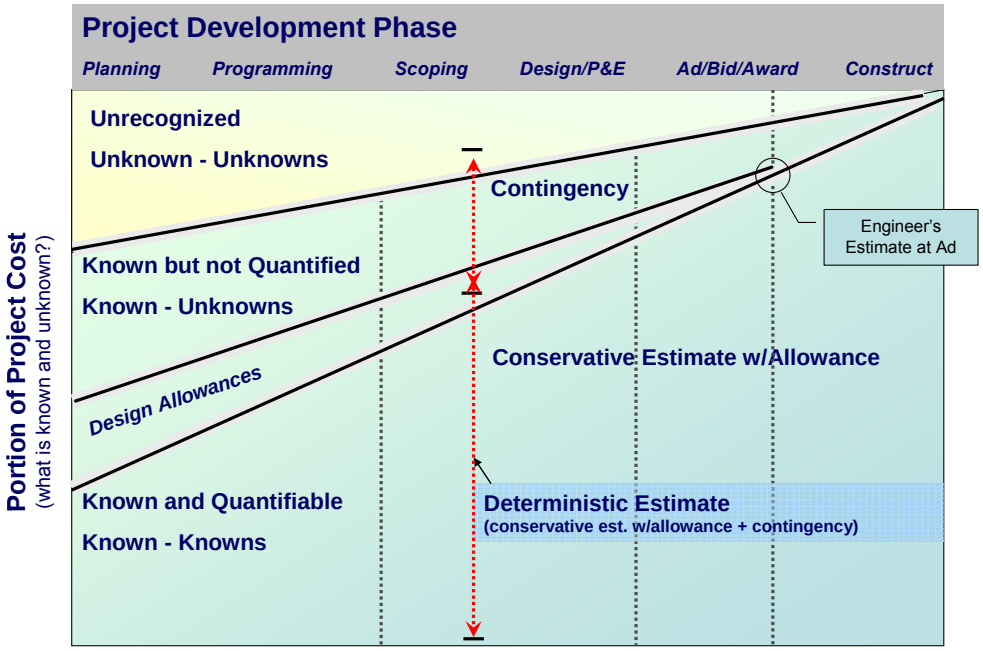
Good risk management planning begins with sound project management practices including review of organizational policies and guidance, Project Initiation and Team Alignment, and Project Planning steps as provided for in the WSDOT Project Management Online Guide. **Risk Management must commence early in the project development process** and proceed as project knowledge evolves and project information increases in quantity and quality. Monitoring project development and risk exposure continues formal risk assessments of risk may occur several times through the life of the project. People and resources involved in the project, project management plan development, and risk management plan development must consider the resources needed for project risk management and build it into their project development budget and schedule. Risk management activities, including risk workshops (such as CRA, CEVP or other meetings) should be part of the Project Workplan and built into the project schedule and budget.

As the project develops and moves through scoping and early design phases, more knowledge about the project becomes available, see Figure 1-1. With the rising knowledge about a project's scope comes an understanding that contending with some elements of the project will require significant additional resources. Such elements could be related to scope, environmental mitigation and permitting, rising cost of right-of-way as corridors develop in advance of the project, utilities, seismic and other considerations. Traditional estimating practices tend to produce "the number" for a project. But the single number masks the critical uncertainty inherent in a particular project. It implies a sense of precision beyond what can be achieved during planning, scoping or early design phases. WSDOT has come to the understanding that an estimate is more accurately expressed not as a single number but as a range.

To determine an accurate estimate range for both cost and schedule, risk must be measured. Formerly, WSDOT measured risk based on the estimator's experience and best judgment, without explicitly identifying the project's uncertainties and risks. That has changed. Estimates now comprise two components: the base cost component and the risk (or uncertainty) component. The Base Cost represents the cost which can reasonably be expected if the project materializes as planned. . The base cost does not include contingencies. Once the base cost is established, a list of risks is created of both opportunities and threats, called a "risk register." The risk assessment replaces general and vaguely defined contingency with explicitly defined risk events. Risk events are characterized in terms of probability of occurrence and the consequences of each potential risk event.

In Executive Order E 1053 Employees that manage projects are directed to actively manage project sites, and project E 1038.00 WSDOT establishes, as policy, to proactively assess and respond to any risks that may affect the achievement of WSDOT's strategic performance based objectives and their intended outcomes. It further goes on to direct employees to support the department's efforts to identify, share and manage risk across all organizations and functions. Risk reviews are an integral part of budget development, and the intent is for the department to make informed decisions about risk tolerance. In can be inferred that determined Enterprise Risk Management will require comprehensive Project Risk Management, and Project Risk Management is also a key component of a Project Management Plan, which is required for all WSDOT projects.

We then, as stewards of the public trust, must endeavour to inform decision-makers of the uncertainty and risk associated with the projects we develop. We must understand risk tolerance and we must weigh the value of project decisions with risks associated with the project.



Evolution of Project Knowledge through Project Development
Figure 1-1

In Chapter 5 of the book "Risk, Uncertainty and Government", it notes "…lawyers and economists are accustomed to think of contracts for future performance as devices for allocating risks of future events". In order for us to understand this allocation of risk -projects must be examined and the uncertainty and risks must be documented and characterized.

We can think of risk management as depicted above, the two pillars of risk management are "IDENTIFY and ANALYZE" the risks then, as depicted in the second pillar "RESPOND, MONITOR and CONTROL" project risk.

Unless we incorporate the second pillar we are not realizing the full value of risk management. When preparing our project management plan and work activities for our project, we must include both pillars of risk management in our plan.


Risk Management Planning
"How to"

How to Plan for Project Risk Management

Do you plan to manage risk for your project? YES! Then include risk management in your project management plan.

#1 Determine the Level of Risk Assessment for your Project (see Table 1-1).

#2 Incorporate risk management activities into the project schedule (see Table 1-2 and Figures).

#3 Make Risk Management an agenda item for regularly scheduled project meetings.

#4 Communicate the importance of risk management to the entire project team.

#5 Establish the expectation that risk will be managed, documented and reported.

Helpful Hints for Risk Management Planning

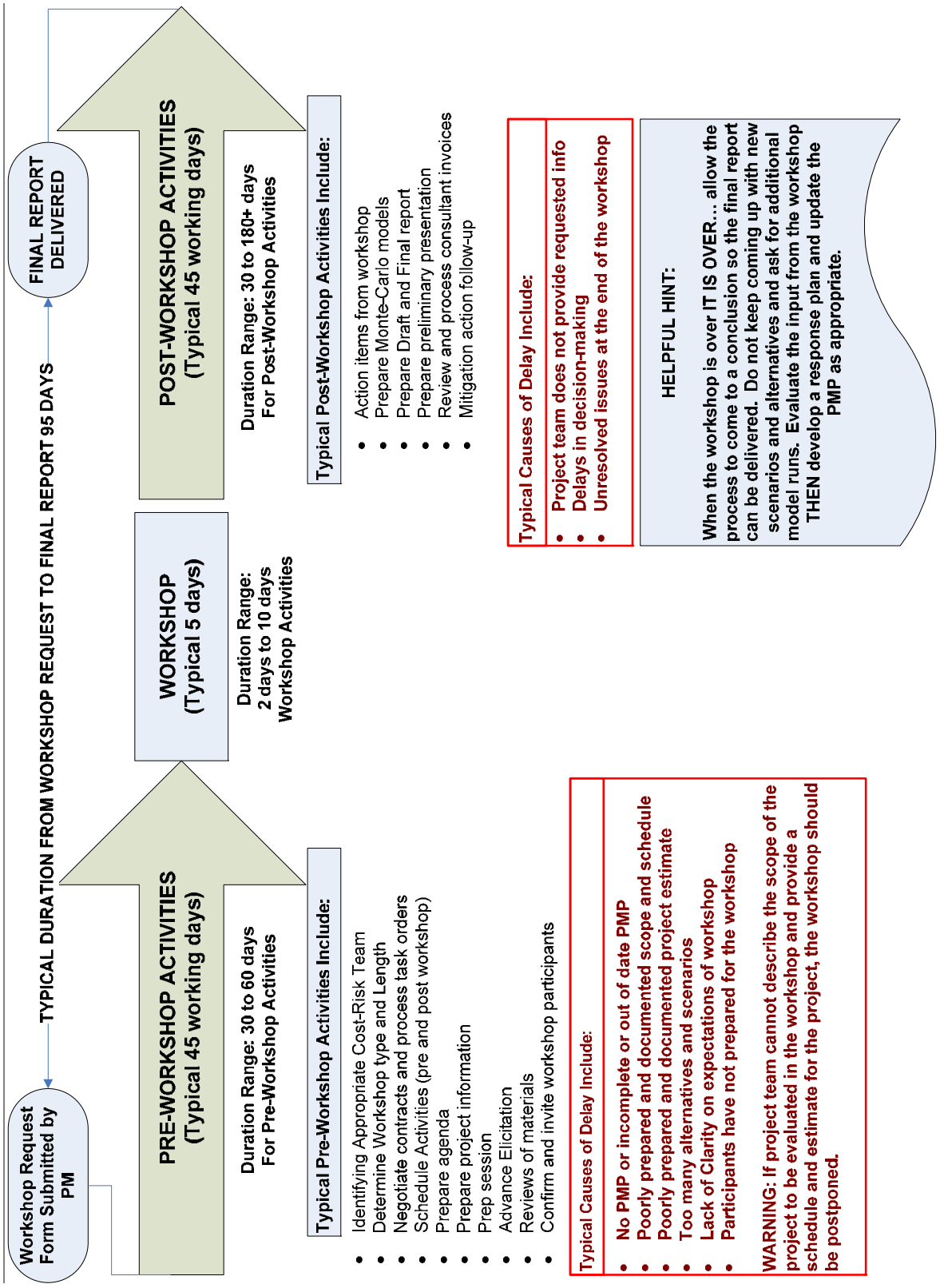
- Risk assessment should begin early, but there must be enough known about the project to understand what is being assessed. This will of course be to varying levels of detail depending on the point in project development at which the risk assessment is conducted (planning, scoping, design/ps&e) –hence schedule risk assessments at appropriate times.
- Allow time in the schedule for prep activities, this includes review and QA/QC of project schedules and cost estimates at appropriate times.
- Allow budget for risk assessment, risk management and risk response activities.
- Report on status of Project Risk in regularly scheduled project meetings.
- Know the organization's tolerance for risk – Are project managers (and upper management) risk averse or risk seeking? How much risk is the organization will to accept? Knowing the answers to these questions will help with risk management and contribute to the decision-making process when determining risk-response actions.
- Contact SAEO and discuss the possibility of combing the risk assessment workshop with a VE study.

	Project Size ($M)	Risk Assessment Level	Notes
Less Formal Risk Assessment	0 to 10	Project Team Risk Assessment Project Management Online Guide (PMOG) Risk Management Plan ***Qualitative Tool***	The Project team assesses each identified risk for its probability of occurrence and its impact on project objectives. Project teams may request assistance from subject matter experts or functional units to assess the risks in their respective fields. The self-modeling spreadsheet can be used for any project.
	10 to 25	Project Team Risk Assessment Self-Modeling Spreadsheet ***Quantitative Tool***	
More Formal Risk Assessment (Workshops)	25 to 100	Cost Risk Assessment (CRA) Workshop ***Quantitative Tool***	The team, working collaboratively with independent subject matter experts, reviews and/or validates cost and schedule estimating and identifies, characterizes and analyzes risks. Accomplished in a structured workshop setting. Modeling can be accomplished with off the shelf software or using the self-modeling spreadsheet.
	Over 100	Cost Estimate Validation Process (CEVP) Workshop ***Quantitative Tool***	

Determine the Level of Risk Assessment
Table 1-1

Less Formal Risk Assessment (does not require a Formal Workshop) Milestones include:	Formal Workshop (CRA/CEVP) Milestones include:
• Project Scope, Schedule and Estimate are complete (apt for the level of development) • Prep meeting (initial review of areas of concern, determine tool qualitative or self-modeling) • Risk Meeting (risks are identified and characterized) • Risk Response Actions Developed • Risk Response Actions Implemented	• Workshop Request Form submitted • Project Scope, Schedule and Estimate are complete (apt for the level of development) • Prep Session (flowchart project; determine subject matter experts; additional prep items) • Workshop • Preliminary Results Presented • Draft Report • Final Report

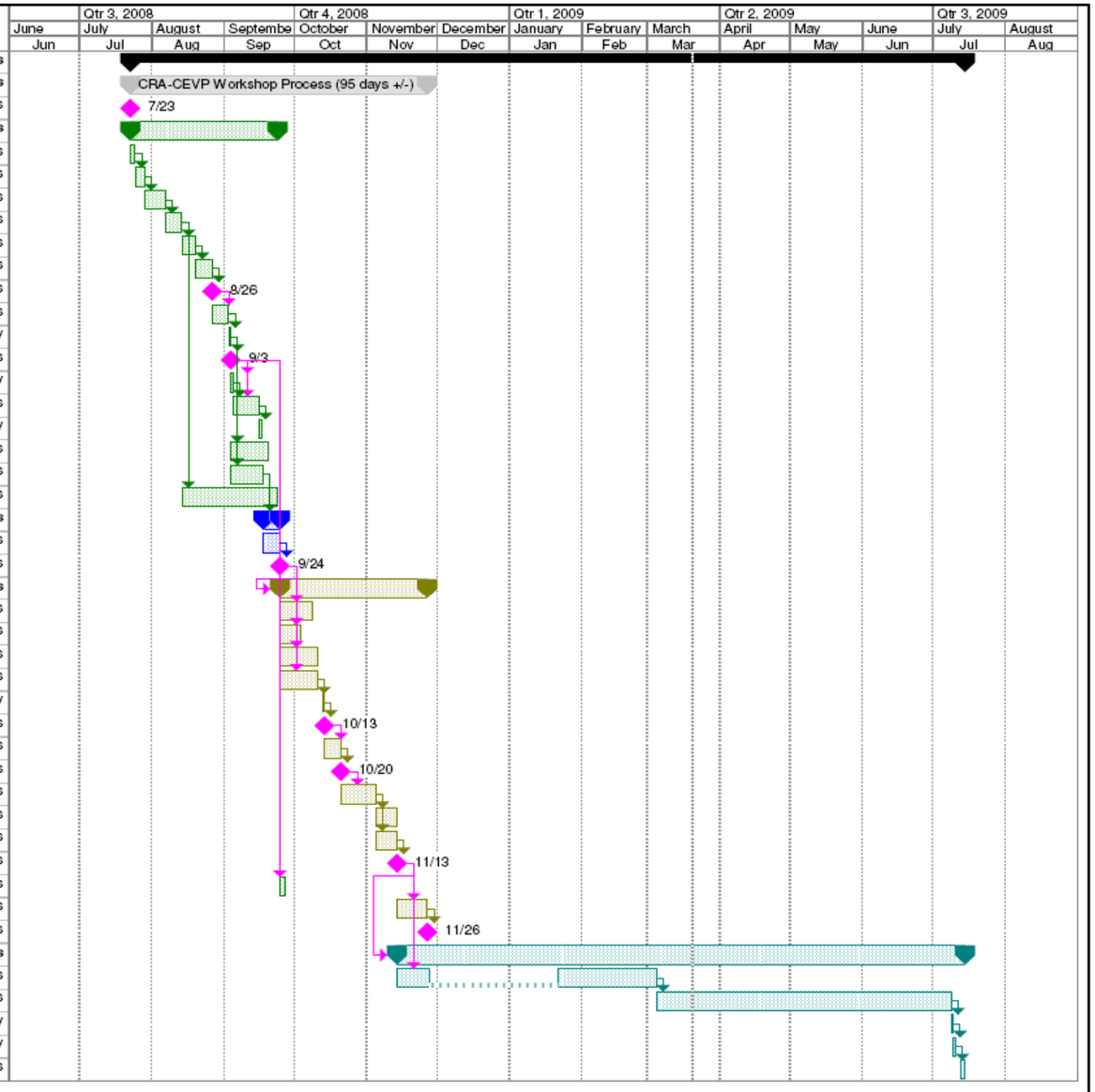
Include Risk Management Milestones in the project schedule.
Table 1-2



Simplified Workshop Timeline

Figure 1-2

ID		Task Name	Duration
1		**PROJECT RISK MANAGEMENT (continual PM activity)**	**255 days**
2		**CRA-CEVP Workshop Process (95 days +/-)**	**91 days**
3		Workshop Request Form submitted by PM	0 days
4		**PRE-Workshop Activities**	**45 days**
5		CREM, works with PM to Identify appropriate Cost-Risk Team	2 days
6		CREM Determines appropriate workshop type and length	2 days
7		CREM Negotiates with Consultants (confirm with PM)	7 days
8		CREM, works with PM Schedules pre-workshop, workshop, and post-workshop activities	5 days
9		CREM Prepares and processes task orders	4 days
10		Project Team prepares materials for prep session and begins preparing for workshop	5 days
11		REALITY CHECK (is project team ready?) > Project Scope, Schedule, Estimate for workshop)	0 days
12		CREM Prepares and distributes PREP Session agenda and sends invites	5 days
13		PREP SESSION (run by CREM results in: Draft Flowchart, Estimate, Participants List)	1 day
14		MILESTONE > PREP SESSION COMPLETE	0 days
15		PM Sends e-mail reminder to Region Participants/SMEs for workshop	1 day
16		CREM schedules and conducts Advance Elicitation with appropriate parties (review Flowchart & E	7 days
17		CREM Sends invites to all workshop participants for workshop	1 day
18		Project Team prepares for workshop (review Flowchart, Estimate and Participants List)	12 days
19		CREM, working with PM, finalizes workshop agenda and sends to participants	10 days
20		Project Team makes project information available via e-mail, ftp, and/or other	29 days
21		**WORKSHOP ACTIVITIES**	**5 days**
22		WORKSHOP (run by CREM)	5 days
23		MILESTONE > WORKSHOP COMPLETE	0 days
24		**POST Workshop Activities**	**45 days**
25		Accomplish Actions Items from Workshop (i.e. Flowchart & Estimate issues)	10 days
26		Cost Lead prepares their portion of the DRAFT REPORT	7 days
27		Risk Lead prepares models and writes DRAFT REPORT	12 days
28		Risk Lead prepares preliminary presentation	12 days
29		Risk Lead delivers preliminary presentation	1 day
30		Preliminary Presentation Complete	0 days
31		RISK LEAD ASSEMBLES DRAFT REPORT	5 days
32		MILESTONE > DRAFT REPORT COMPLETE	0 days
33		PROJECT TEAM REVIEWS & COMMENTS ON DRAFT REPORT	11 days
34		Cost Lead prepares their portion of the FINAL REPORT	7 days
35		Risk Lead finalizes models and writes FINAL REPORT	7 days
36		MILESTONE > FINAL REPORT COMPLETE	0 days
37		PM makes sure payment Groups are setup in TRAINS	2 days
38		CREM Reviews and Pays Invoices	9 days
39		Invoices Paid and Task Order Closed	0 days
40		**POST REPORT ACTION (RISK RESPONSE)**	**173 days**
41		PM Updates Project Management Plan/Risk Management Plan	40 days
42		PM Implements Risk Response Strategies	90 days
43		PM Monitors effectiveness of risk response actions	1 day
44		Update Risk Management Plan with response costs and estimated value of risk avoided	1 day
45		Peform Post-Mitigation Analysis and Report	2 days



Project: CRA-CEVP Workshop Proces
Date: Fri 3/20/09

Task | Progress | Summary | External Tasks | Deadline
Split | Milestone | Project Summary | External Milestone

Page 1

Risk Management Schedule
(with workshop activities and post workshop activities)
Figure 1-3

Chapter 2 Risk Identification

Risk identification occurs through each of the four phases of project development:

1. Planning
2. Scoping
3. Design/Plans, Specifications and Estimate (Engineer's Estimate)
4. Construction

As projects evolve through project development so too the risk profile evolves project knowledge and understanding grows; hence previously identified risks may change and new risks identified throughout the life of the project.

Risk Identification: Inputs, Tools and Techniques, Outputs

Risk Identification Inputs

The first and most important input is a defined project. In order to fully understand and assess the risks that our projects are exposed to we must first insure that there is a mutual understanding of the project under evaluation. This means that when we embark to meaningfully and deliberately focus on the risks and uncertainties our project will face, we must first be able to define the project in terms of scope, schedule and estimate -commensurate with the level of project development at the time of risk analysis.

Projects tend to develop in small steps; this incremental process of project development is termed, by some, *progressive elaboration*. "Progressive elaboration means developing in steps, and continuing by increments. For example, the project scope will be broadly described early in the project and made more explicit and detailed as the project team develops a better and more complete understanding of the objectives and deliverables. Progressive elaboration should not be confused with scope creep." *PMBOK*

Risk Identification Tools and Techniques

Try to identify as many risks as possible that may affect project objectives. State the assumptions for risk identification and analysis and delineate thresholds for risks. For example a project team may want to describe all cost risks below $100,000 as minor and all schedule risks less than 2 weeks as minor thereby not spending inordinate amounts of time on those risks and allowing them to focus on more significant risks (assumptions and thresholds for risk assessment will be influenced by the size and complexity of the project, project environment, and the owners'

tolerance for risk). There are a wide variety of techniques used for risk identification. Some common techniques, used at WSDOT are provided below.

Documentation Reviews

Peer level reviews of project documentation, studies, reports, preliminary plans, estimates and schedules are a common and early method to help identify risks that may affect project objectives.

Information Gathering

- **Brainstorming** Formal and informal brainstorming sessions with project team members and extended project team members such as specialty groups, stakeholders and regulatory agency representatives is a technique for risk identification.. This technique can be scaled for use on the simplest to the most complex projects. This technique can also be tailored to specific areas of interest for the project risk, for example if a project manager is most concerned about Geotech conditions a brainstorming session on Geotech can be convened, and so forth.
- **Lessons Learned Database** Searching for lessons learned using key-words in the WSDOT lessons learned database that are relevant to your project can provide an abundance of information on projects that may have faced similar risks.
- **Other methods** There are many techniques, some common techniques include: questionnaires and surveys, interviewing, checklists, and examination of the Work Breakdown Structure for the project with appropriate specialty groups, asking "what-if" questions, for example "what-if we miss the fish window?" or "what-if our environmental documentation is challenged and we have to prepare an EIS?" etc.

Risk Identification Outputs

An expected deliverable from Risk Identification includes a preliminary "risk register" which documents the following information:

Identification # for each risk identified

A unique number is assigned to each risk for tracking purposes. If available this can be done utilizing an established Risk Breakdown Structure (RBS); the WSDOT RBS is provided in the appendix of this document.

Date and phase of project development when risk was identified

Document the date the risk was identified and which project development phase (planning, scoping, design/PS&E, construction).

Name of Risk (does the risk pose a threat or present an opportunity?)

Each identified risk should have an appropriate name, for example "NEPA Delay" or "Reduction in Condemnation"; the nature of the risk with respect to project objectives (threat or opportunity) should also be documented. This can be done using the Risk Breakdown Structure (RBS) for naming conventions.

Detailed Description of Risk Event

The detailed description of the identified risk; the description must be provide information that is **S**pecific, **M**easurable, **A**ttributable (a cause is indicated), **R**elevant, and **T**ime bound (SMART). The description must be clear enough and thorough enough so that others reading about the description of the risk will understand what it means.

Risk Trigger

Each identified risk must include the risk trigger(s). Risks rarely just suddenly occur; usually there is some warning of imminent threat or opportunity. These warning signs should be clearly described and information about the risk trigger should be documented. For example "NEPA Approval Date" may be considered a risk trigger on a project that has a risk of a legal challenge, or other as appropriate.

Risk Type

Does the identified risk affect project schedule, cost, or both?

Potential Responses to Identified Risk

Document, if known, possible response actions to the identified risk –can the identified threat be avoided, transferred, mitigated or is it to be accepted? Can the identified opportunity be exploited, shared or enhanced?

Comments about Risk Identification

Risk Management is an iterative process; risks should be reviewed regularly and as new risks are identified they should be documented and assessed. The resulting risk register should only be considered preliminary until the completion of additional and appropriate activities that may include any or all of the techniques listed above and/or more robust processes such as Cost Risk Assessment and Cost Estimate Validation Process (CRA/CEVP) workshops. More detail about the WSDOT workshops for CRA/CEVP is offered later in this document, and at: www.wsdot.wa.gov/Projects/ProjectMgmt/RiskAssessment

Identify Risk Events

How to Identify Risk

#1 Determine risk thresholds for the project (establish a minimum dollar amount and time duration considered significant for the project under evaluation).

#2 Focus on identifying large significant risks which affect project objectives.

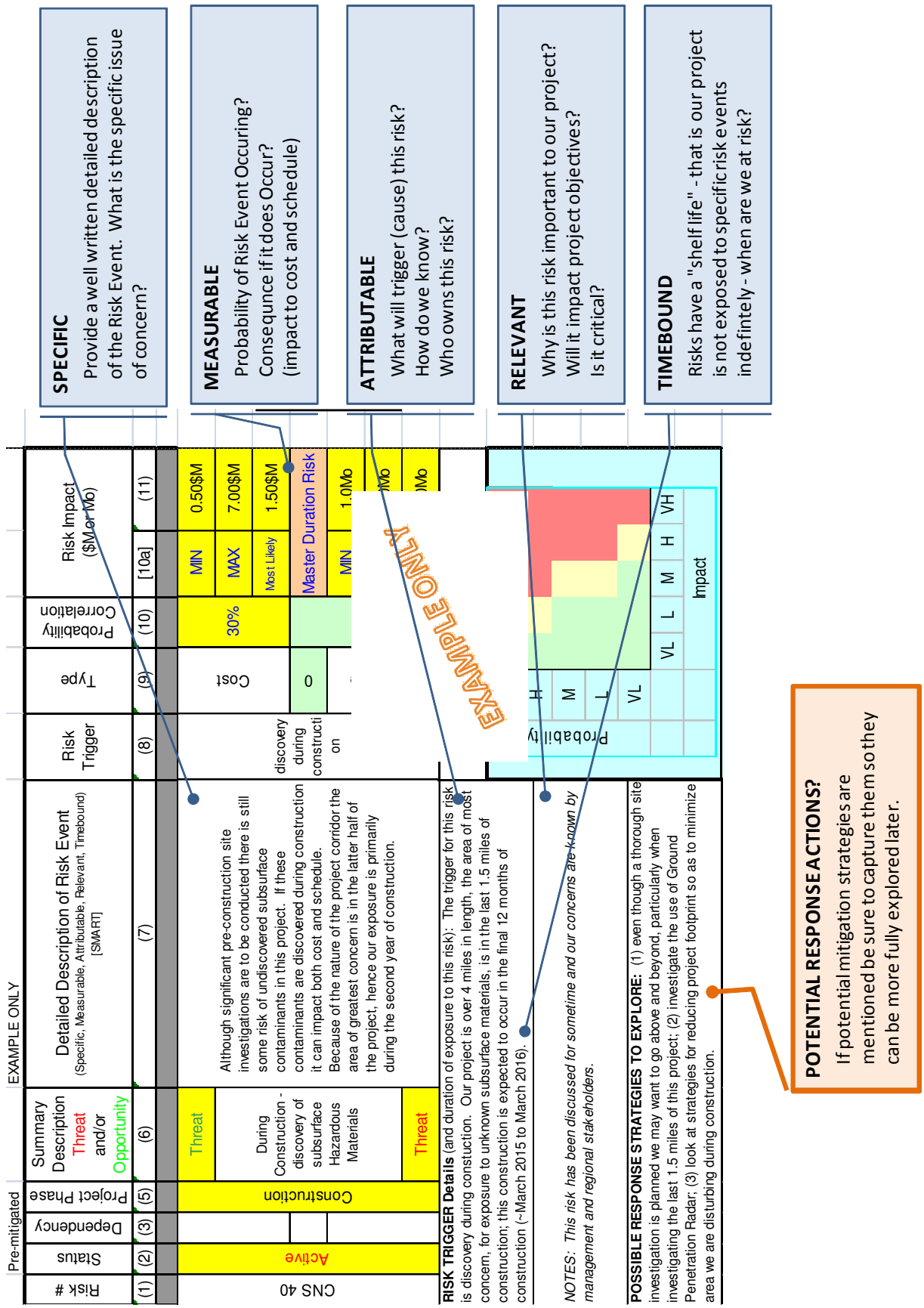
#3 Carefully document and describe risks in a risk register.

HELPFUL HINTS FOR RISK IDENTIFICATION

- Determine, for your project, what constitutes "significant" risk.
- Thoroughly describe the risk – there is a form in the following pages to help with this or you may create your own.
- Include specialty groups and/or other persons who may have meaningful input regarding the challenges the project may face.
- Determine who "owns" the risk and who will develop a response.

Brainstorming - is an effective method. Brainstorming can range from a small informal project team effort for simpler projects to a full-blown CEVP workshop. Effective brainstorming requires a skilled facilitator, working together with the project team and specialists who can bring additional expertise.
Checklists and/or Questionnaires to `specialty groups - checklists/questionnaires are a quick and easy-to-use technique but limited in nature; they only deal with the items on the list. Each project is unique; hence a standard list will often not capture the project specific risks of most concern. Nonetheless a checklist/questionnaire can spark thinking prior to a more formal brainstorming process.
Examination of past similar projects - lessons learned from past projects help us to avoid repeating mistakes; using past examples requires prudent and objective judgment, since a previous project may be similar but is nonetheless different because each new project has unique requirements and features, including uncertainties and risks. WSDOT Lessons Learned website: http://eefmapps.wsdot.wa.gov/fmi/xsl/Lessons/Main.xsl?-db=DebriefReport&-lay=LessonWebForm&MonthlyHighlight=Yes&-find
Combination of above methods and/or others - It is quite likely that for most projects a combination of the above methods will be used to identify risks. The important thing is that once identified the risks are properly documented.
Figure 2-1 Blank template for documenting identified risks (tailor to your needs). Figure 2-2 Example of how template is used. Figure 2-3 Risk Breakdown Structure for categorizing and organizing risks. Figure 2-4 Example of risk identification using spreadsheet from Project Management Online Guide found at: www.wsdot.wa.gov/Projects/ProjectMgmt/OnLine_Guide/Phase_Guides/Pre-Construction/Pre-Construction_files/slide0001.htm

Risk Identification
Table 2-1


SPECIFIC
Provide a well written detailed description of the Risk Event. What is the specific issue of concern?
MEASURABLE
Probability of Risk Event Occuring?
Consequnce if it does Occur?
(impact to cost and schedule)
ATTRIBUTABLE
What will trigger (cause) this risk?
How do we know?
Who owns this risk?
RELEVANT
Why is this risk important to our project?
Will it impact project objectives?
Is it critical?
TIMEBOUND
Risks have a "shelf life" - that is our project is not exposed to specific risk events indefintely - when are we at risk?
EXAMPLE ONLY
Pre-mitigated
Risk #
Status
Dependency
Project Phase
Summary Description Threat and/or Opportunity
Detailed Description of Risk Event (Specific, Measurable, Attributable, Relevant, Timebound) [SMART]
Risk Trigger
Type
Probability Correlation
Risk Impact ($M or Mo)
(1) (2) (3) (5) (6) (7) (8) (9) (10) [10a] (11)
CNS 40
Active
Construction
Threat
During Construction - discovery of subsurface Hazardous Materials
Threat
Although significant pre-construction site investigations are to be conducted there is still some risk of undiscovered subsurface contaminants in this project. If these contaminants are discovered during construction it can impact both cost and schedule. Because of the nature of the project corridor the area of greatest concern is in the latter half of the project, hence our exposure is primarily during the second year of construction.
discovery during construction
Cost
0
30%
MIN
MAX
Most Likely
0.50$M
7.00$M
1.50$M
Master Duration Risk
MIN
1.0Mo
EXAMPLE ONLY
Probability
H
M
L
VL
VL
L
M
H
VH
Impact
RISK TRIGGER Details (and duration of exposure to this risk): The trigger for this risk is discovery during constuction. Our project is over 4 miles in length, the area of most concern, for exposure to unknown subsurface materials, is in the last 1.5 miles of construction; this construction is expected to occur in the final 12 months of construction (~March 2015 to March 2016).
NOTES: This risk has been discussed for sometime and our concerns are known by management and regional stakeholders.
POSSIBLE RESPONSE STRATEGIES TO EXPLORE: (1) even though a thorough site investigation is planned we may want to go above and beyond, particularly when investigating the last 1.5 miles of this project; (2) investigate the use of Ground Penetration Radar; (3) look at strategies for reducing project footprint so as to minimize area we are disturbing during construction.
POTENTIAL RESPONSE ACTIONS?
If potential mitigation strategies are mentioned be sure to capture them so they can be more fully explored later.

Pre-mitigated EXAMPLE ONLY

Risk #	Status	Dependency	Project Phase	Summary Description Threat and/or Opportunity	Detailed Description of Risk Event (Specific, Measurable, Attributable, Relevant, Timebound) [SMART]	Risk Trigger	Type	Probability Correlation	Risk Impact ($M or Mo)
(1)	(2)	(3)	(5)	(6)	(7)	(8)	(9)	(10)	[10a] (11)
CNS 40	Active		Construction	Threat	Although significant pre-construction site investigations are to be conducted there is still some risk of undiscovered subsurface contaminants in this project. If these contaminants are discovered during construction it can impact both cost and schedule. Because of the nature of the project corridor the area of greatest concern is in the latter half of the project, hence our exposure is primarily during the second year of construction.	discovery during construction	Cost	30%	MIN 0.50$M MAX 7.00$M Most Likely 1.50$M
				During Construction - discovery of subsurface Hazardous Materials			0		Master Duration Risk MIN 1.0Mo)Mo)Mo
				Threat					

EXAMPLE ONLY

RISK TRIGGER Details (and duration of exposure to this risk): The trigger for this risk is discovery during constuction. Our project is over 4 miles in length, the area of most concern, for exposure to unknown subsurface materials, is in the last 1.5 miles of construction; this construction is expected to occur in the final 12 months of construction (~March 2015 to March 2016).

NOTES: This risk has been discussed for sometime and our concerns are known by management and regional stak eholders.

POSSIBLE RESPONSE STRATEGIES TO EXPLORE: (1) even though a thorough site investigation is planned we may want to go above and beyond, particularly when investigating the last 1.5 miles of this project; (2) investigate the use of Ground Penetration Radar; (3) look at strategies for reducing project footprint so as to minimize area we are disturbing during construction.

Project Title:
Project Manager:
Date Risk Identified:

CN Duration Estimate
PE Estimate
RW Estimate
CN Estimate

Risk ID Sheets.xls

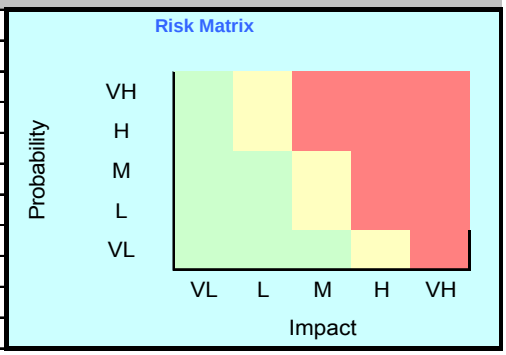
Pre-mitigated or Post mitigated ?

Parameters for Monte-Carlo Modeling

Risk #	Status	Dependency	Project Phase	Summary Description Threat and/or Opportunity	Detailed Description of Risk Event (Specific, Measurable, Attributable, Relevant, Timebound) [SMART]	Risk Trigger	Type	Probability Correlation	Risk Impact ($M or Mo)	
(1)	(2)	(3)	(5)	(6)	(7)	(8)	(9)	(10)	[10a]	(11)
1	Retired		Construction	*Threat*			Cost		MIN	
									MAX	
									Most Likely	
							0		Master Duration Risk	
							Schedule		MIN	
									MAX	
				Threat					Most Likely	

Supplemental notes about this risk event

Risk Trigger Details:
Risk Owner:
Risk Breakdown Structure # (RBS#)
Work Breakdown Stucture # (WBS#)
Critical Path (yes or no)
Response Actions (action to be taken)



Action by date:
Status review date:
Status review date:

ADDITIONAL NOTES:

Actions to implement strategy:

What needs to be done?	Who will do it?	Due date?

Blank Template For Documenting Identified Risks (Tailor to Your Needs)
Figure 2-1

Project Title:	*Risk Management Guide Example*	*CN Duration Estimate*	*10.0Mo*
Project Manager:	*Scott Adams*	*PE Estimate*	*2.0 $M*
Date Risk Identified:	*1-Feb-29*	*RW Estimate*	*8.0 $M*
		CN Estimate	*30.0 $M*

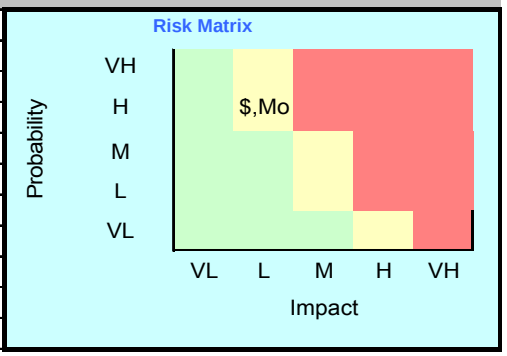
Risk ID Sheets.xls

Pre-mitigated or Post mitigated ?

Risk #	Status	Dependency	Project Phase	Summary Description Threat and/or Opportunity	Detailed Description of Risk Event (Specific, Measurable, Attributable, Relevant, Timebound) [SMART]	Risk Trigger	Type	Probability Correlation	Parameters for Monte-Carlo Modeling: Risk Impact ($M or Mo)	
(1)	(2)	(3)	(5)	(6)	(7)	(8)	(9)	(10)	[10a]	(11)
1	Retired		*Pre-construction*	***Threat***	Complex project, might require additional time (longer than average) to review. Potential agency staff changes. Tribal issues include fishing rights, effects on fish and habitat, and other environmental concerns. Appeals can be made on any of the major permits, whether based on actual issues with the permits or not. The following specific issues were highlighted: • Shoreline permits from various jurisdictions are of particular concern shoreline permits are easy to challenge and typically result in significant delays. There is a process to weed out frivolous appeals. • New NPDES outfalls (appealable) • HPA issues with WDFW Coast Guard permits for THE channel.	***Determination decisions by several agencies. Revisions to our estimated areas of impact.***	*Cost*	70%	MIN	0.25$M
				Permits and Permit Appeals					MAX	2.00$M
									Most Likely	0.50$M
							0		Master Duration Risk	
							Schedule		MIN	1.0Mo
									MAX	8.0Mo
				Threat					Most Likely	5.0Mo

Supplemental notes about this risk event

Risk Trigger Details:	***Should know by the ides of March.***
Risk Owner:	***Mr. Ule Givens***
Risk Breakdown Structure # (RBS#)	***ENV 30.1***
Work Breakdown Stucture # (WBS#)	***PC-18***
Critical Path (yes or no)	***yes***
Response Actions (action to be taken)	
One of the best tools we have to avoid this risk is a concerted, committed & sustained effort	
to address env. permits upfront & thoroughly. Including verification of jurisdictions	
and parties of concern and clarify understanding and expectations of all parties.	
To this end we will form a team to puruse this effort with appropriate representatives from	
each permitting authority with review dates and commitments.	
Action by date:	***February 30, 2929***
Status review date:	***March 32, 2929***
Status review date:	***April 31, 2929***



ADDITIONAL NOTES:

Actions to implement strategy:

What needs to be done?	*Who will do it?*	*Due date?*
Communication with parties.	***Project Mgr***	***NOW***
Succession plan for staff changes.	***Business Mgr***	***2929-Feb***
Decisions ASAP on design elements.	***Executive Oversight***	***2929-March***

Example of How Template is Used

Figure 2-2

Level 1	Project Risk									
Level 2	**Environmental & Hydraulics ENV**	**Structures & Geotech STG**	**Design / PS&E DES**	**Right-of-Way** (including Access and Acquisition**) ROW**	**Utilities UTL**	**Railroad RR**	**Partnerships and Stakeholders PSP**	**Management / Funding MGT**	**Contracting and Procurement CTR**	**Construction CNS**
Level 3	ENV 10 NEPA/SEPA Documentation Completion (incl. Section 4f, etc.) --- NEPA/SEPA Challenges	STG 10 Potential Changes to Structures Design (Bridge Superstructure, Retaining Walls)	DES 10 Potential Changes to roadway design (including vertical and/or horizontal alignment, earthwork, pavement, etc.)	ROW 10 Issues Associated with Development of ROW Plan	UTL 10 Utility Design Coordination and Agreements	RR 10 Railroad Design Coordination and Agreements	PSP 10 Tribal Issues	MGT 10 Change in Project Managers and/or other key Leadership	CTR 10 Change in Project Delivery Method	CNS 10 Traffic Control and Staging Issues (MOT/WZTC)
	ENV 20 ESA Issues (incl. consultation, Biologic Assessments/Biological Opinions, Fish Passage)	STG 20 Potential Changes to Geotechnical Design Foundations, Liquefaction, Mitigation, etc. ---------- Challenging Geotech Conditions	DES 20 Approval of Design Deviations --- Changes to roadway design criteria (i.e. shoulder width, sight distance, etc.)	ROW 20 Uncertainty in Future ROW Escalation Rate (Project-Specific, including change in land use, urbanization, etc.)	UTL 20 Utility relocations and conflicts	RR 20 Railroad Coordination during construction (flagging, work restrictions, work windows, etc.)	PSP 20 Public Involvement Issues --- Other Interagency Agreements (i.e. Sound Transit, USFS, cities, counties, etc.)	MGT 20 Delayed Decision Making	CTR 20 Issues Related to Contract Language (Contract Packaging, Warranties, Liquidated Damages, DBE, Insurance/Bonding, etc.)	CNS 20 Construction Permitting Issues (incl. work restrictions)
	ENV 30 Environmental Permitting (incl. Appeals)	STG 30 Changes to Structural Design Criteria (e.g., seismic)	DES 30 Changes to Architectural, CSS, Landscape Design	ROW 30 Limited Access (Interchange Justification Report - IJR, Access Hearing, etc.)		RR 30 Contractor Right of Entry Requirements	PSP 30 Additional Scope in Response to Third Party Concerns (e.g., artwork, shared-use pathways, intersection improvements, etc.)	MGT 30 Availability of Funding / Cash Flow Restrictions	CTR 30 Delays in Ad/Bid/Award Process (Addenda, Protests, etc.)	CNS 30 Work Windows (Weather, Fish, etc.)
	ENV 40 Archaeological/Cultural Discoveries, historic property impacts & mitigation (Section 106)		DES 40 Projects by other agencies affected by or affecting this project (design coordination)	ROW 40 Managed Access (Appeal Hearing, etc.)				MGT 40 Political/Policy Changes	CTR 40 Market Conditions (non-competitive bidding environment) Lack of Qualified Bidders	CNS 40 Construction Schedule Uncertainty (general, including timing of award)
	ENV 50 Hazardous Materials Groundwater and Soil Contamination (PE, RW, CN)		DES 50 Potential Changes to Design of Permanent Traffic Items (ITS, Illumination, Intersection, etc.)	ROW 50 ROW Acquisition Issues (condemnation, relocations, demolitions, etc.)				MGT 50 State Workforce Limitations	CTR 50 Delays in Procurement of Specialty Materials or Equipment and associated cost premiums	CNS 50 Marine/ Over Water Construction Issues
	ENV 60 Wetlands / Stream / Habitat Mitigation		DES 60 Design / PS&E Reviews --- Additional Scope Driven by Internal Considerations (e.g., Maintenance, Traffic Projections, Tolling, extend project terminii, change to purpose and need, etc.)	ROW 60 Additional ROW is required (including full vs partial takes): Temporary and Permanent Access Breaks - FHWA approval --- Construction / Subterranean Easements					CTR 60 Contractor Non-Performance	CNS 70 Earthwork Issues (re-use, haul, disposal, etc.)
	ENV 70 Stormwater, Potential Changes to Flow Control or Runoff Treatment/Hydraulic Requirements								CTR 70 Availability of Specialty Labor/Labor and/or Productivity Disruptions	CNS 80 Coordination with Adjacent Projects During Construction
	ENV 80 Environmental Impacts during Construction (includng water quality, TESC etc.)									CNS 90 Contractor Access / Staging Coordination and Constructability Issues
	ENV 90 Permanent Noise Mitigation									CNS 100 Construction Accidents
	ENV 900 Other Environmental Issues	STR 900 Other STR Issues	DES 900 Other Design Issues	ROW 900 Other ROW Issues	UTL 900 Other UTL Issues	RR 900 Other RR Issues	PSP 900 Other PSP Issues	MGT 900 Other MGT Issues	CTR 900 Other CTR Issues	CNS 900 Other Construction Issues (including unanticipated change orders/claims)

Risk Breakdown Structure
Figure 2-3a

The RBS provides several functions and benefits to the project team and to management, including:
1) Consistency with taxonomy (wording);
2) Organizes risk events into common categories;
3) Helps to identify trends with respect to common usage of risk event categories & event types along with their probability and impact values;
4) Helps to identify common risk events among projects that the Region and HQ offices should be aware of due to their potential cumulative effects; e.g. negotiating agreements with agencies or other municipalities;
5) Provides a basis to work from for risk elicitors during CEVP workshops;
6) Provides a basis for development of independent risk surveys for those that are unable to attend a CEVP workshop.
This RBS serves as a starting point in assessing project risks in CEVP and CRA workshops; and also for smaller projects that may not conduct a formal workshop.

RBS CODE	RISK TRIGGER (CAUSE or PRECIPITATING EVENT)		RISK EVENT	CONSEQUENCE (effect on project objectives)	PROBABILITY	IMPACT ($)	IMPACT (TIME)
ENV 10.01	As a result of…	the public involvement process	a challenge to the NEPA/SEPA document may occur	which would delay delivery of the EA document.	70%	↑$5M	8 weeks
ENV 10.02	Because of…	public pressure and internal reviews	a challenge to the level of environmental documentation may occur,	resulting in the need to prepare an EIS, adding scope and cost and lengthening the schedule.	10%	↑$0.1M	6 months
ENV 10.03	Due to…	reviews by WSDOT Environmental	the design information may be deemed inadequate for NEPA/SEPA approval	leading to additional design work, added cost, and schedule delays.	10%	↑$0.1M	4 months

Risk Breakdown Structure (Example of use)
Figure 2-3b

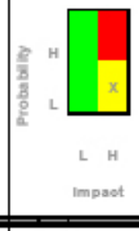
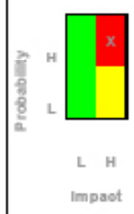
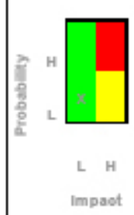
Project Title EXAMPLE for Risk Management Document

Project PIN # #######

Date Feb 31, 2929

Project Mngr Mgr Name **Telephone Number** (xxx) xxx-xxxx

PROJECT RISK MANAGEMENT PLAN

	Risk Identification								Qualitative Analysis			Risk Owner	Risk-Response Strategy		Monitoring and Control	
Priority	Status	ID #	Date Identified Project Phase	Risk Event (threat/opportunity)	SMART Column	Risk Trigger	Impact Area	Affected WDL/WBS Level 2 process	Probability	Impact	Risk Matrix		Strategy	ACTION TO BE TAKEN (include advantages and disadvantages)	Status Interval or Milestone Check	Date, Status and Review Comments
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Instructions	Active=actively monitored & controlled Dormant=risk is not currently a high priority, but may become active in the future. Retired=no longer a threat to project objectives.	E1	For example: 6/30/99 Scoping	Risk is an uncertain event or condition that, if it occurs, has a positive (opportunity) or negative (threat) on a project. For example: Wetland Mitigation requires additional R/W.	Detailed description of the risk. Includes information on the risk that is Specific, Measureable, Attributable, Relevant and Timebound. Describe the consequences of the risk to scope, schedule, budget or quality.	Triggers are indications that a risk has occurred or is about to occur. Used to determine when to implement the Risk Response Strategy. For example: Wetland impact is greater than 1/2 acre.	Is the primary impact to the scope, schedule, or budget?	Which WBS element will be modified as part of the response strategy? For example: PC-19 Environmental Permits	Assessment of the likelihood of occurrence. Valid entries are Low or High.	The severity of the risk's effect on the projects objectives. Valid entries are Low or High.	High: Substantial impact on cost, schedule, or technical. Substantial action required to alleviate issue. Low: Minimal impact on cost, schedule, or technical. Normal management oversight is	Name of the person or office responsible for managing the risk event.	Avoidance Transference Mitigation Acceptance (See PM Online Guide for strategy definitions.)	Develop options and determine actions to be taken in response to the risk event. Immediate action may be required at the time of identification. Estimate value of risk and estimate cost to respond.	For example: Completion of wetland delineation expected: 2/28/00	For example: Last status update 4/30/00. Wetland delineation completed 3/15/00. Over 1 acre of wetland was delineated, action is being taken to expedite meetings with regulatory agencies & expedite the effort to provide appropriate wetland mitigation & attain project permits.
	Active	**UTL 20.1**	mm/dd/yyyy Design/PS&E	Threat - Unknown utility impacts (MP 14.7 to MP 19.4).	Areas outside of WSDOT R/W have not been investigated for utilities conflicts; Additional work is required for sewer/stormwater for Smalltown, additional investigation required for water, gas, power, fiber optic, telecommunications, etc.	Multiple Triggers: If found toward the end of design phase may require additional design work and/or R/W acquisition. If found during construction could potentially stop work.	Scope	WBS 185 Prepare Base Maps and Plan Sheets	Low	High		Ms. Eunice Utility	Mitigation	Begin subsurface utility investigations immediately. Assign team member to this issue full time until we are confident all utilities have been identified.	Next check is at QPR on 11/20/2008	
	Active	**ENV 80.3**	mm/dd/yyyy Design/PS&E	Threat - Noise Wall	May be required to build a permanent noise wall pending results of Type 1 Analysis.	Results of Type 1 Analysis will indicate the level of Noise mitigation required.	Scope	WBS 165 Perform Environmental Studies and Prepare Draft Environmental Document (DED)	High	High		Mr. Noiseman	Mitigation	Press for results of noise analysis ASAP. This is a high probability/high impact threat. Carry design as if the noise wall is going to be built (to minimize future rush design work).	Analysis is due 9/30/2008	
	Active	**ENV 40.4**	mm/dd/yyyy Construction	Threat - Cultural Resources may be encountered on D Island	During clearing and grubbing there is a potential for finding historical artifacts, particularly on the northside of D Hill near the water.	Trigger during Design: Archival and/or field investigation reveals artifacts on site. Trigger during CN: Discovery of indicator items and/or artifacts during clearing/grubbing.	Scope	WBS 185 Prepare Base Maps and Plan Sheets	Low	Low		Mr. History	Acceptance	Numerous construcion work in and around the area has occurred in the past. No artifacts have been found.	Supplmental Field Investigation report due: 11/1/2008	

RISK IDENTIFICATION EXAMPLE (Qualitative Risk Management Plan Spreadsheet)

http://www.wsdot.wa.gov/Projects/ProjectMgmt/OnLine_Guide/Phase_Guides/Pre-Construction/PC_Plan_the_Work/PC_Plan_Risk.htm

Spreadsheet from Project Management Online Guide
Figure 2-4

Chapter 3 Qualitative Risk Analysis

Qualitative Risk Analysis assesses the impact and likelihood of the identified risks and develops prioritized lists of these risks for further analysis or direct mitigation.

The team assesses each identified risk for its probability of occurrence and its impact on project objectives. Project teams may elicit assistance from subject matter experts or functional units to assess the risks in their respective fields. (WSDOT PMOG)

Qualitative analysis is often used as…

- an initial screening or review of project risks;
- when a quick assessment is desired;
- the preferred approach for some simpler and smaller projects where robust and/or lengthy quantitative analysis is not necessary.

Qualitative - observations that do not involve measurements and numbers. EXAMPLE the risk of a heavy rainstorm affecting our erosion control is "Very High".

Qualitative assessment - An assessment of risk relating to the qualities and subjective elements of the risk –those that cannot be quantified accurately. Qualitative techniques include the definition of risk, the recording of risk details and relationships, and the categorization and prioritization of risk relative to each other. SOURCE: Project Risk Analysis and Management Guide, 2004 APM Publishing

Qualitative analysis provides a convenient and "user-friendly" way to identify, describe and characterize project risks.

Risk identification, as mentioned in the previous chapter, results in the generation of a risk register. The risk register can be sizeable and it is necessary to evaluate and prioritize the risk events identified in the risk register. Evaluation and prioritization is typically an iterative process and can take place at various points in project development.

A thoroughly developed register of risks, that may affect project objectives, is helpful. We sometimes find ourselves in situations where moving forward is difficult because of indecision. Identifying, describing, and assessing project risks allow us to prioritize risks. Prioritization can free us from indecision by providing specific, documented risk events that we can act on to shift the odds in favor of project success. Prioritizing risks, which present the highest potential for significantly affecting project objectives, gives project managers the information necessary to focus project resources. Prioritization helps us make decisions in an uncertain environment and address project risk in a direct and deliberate manner.

Qualitative analysis utilizes relative degrees of probability and consequence of each identified project risk event in descriptive non-numeric terms; see Figure 3-1 and Figure 3-2 for examples of qualitative risk matrices. Qualitative analysis can provide a prioritized list of risks to work on.


Qualitative Risk Analysis
"How to"

How to perform Qualitative Risk Analysis

Once a risk is identified, including a thorough description of the risk and risk triggers, it can be characterized in terms of probability of occurrence and the consequence if it does occur.

#1 Gather the project team and appropriate persons to discuss project risk. Establish which of the qualitative risk matrices you intend to use, define the terms you plan to use (Very High, High, Medium, Low…. Etc.).

#2 Review the risk information from the risk identification step.

#3 Discuss the risk with the group.

#4 Evaluate the likelihood of the risk occurring by asking the group "How likely is it that this risk will occur?" Record the result that the group agrees on.

#5 Evaluate the consequences if the risk does occur by asking the group "What will be the impacts if this risk does occur?" Record the result that the group agrees on.

#6 Prioritize the risks based on the results of the qualitative analysis. If it is desirable the risks can also be group by category (i.e. Environmental, Structures/Geotech) and ranked within each category.

HELPFUL HINTS FOR QUALITATIVE RISK ANALYSIS

- Invite *appropriate* participants (not too many not too few).
- Define terms.
- Stay focused – put a time limit on discussion if necessary.
- Record the results.
- Prioritize the risks based on the results.

Something to consider: those relatively new to risk analysis sometimes claim, in exasperation, "This is nothing more than guessing". This does not represent the full actuality that assigning values for probability and impact relies on the expertise and professional judgment of experienced participants.

The determination of a value for the probability of occurrence and its consequence to project objectives, if it occurs, is for many a new activity and can seem strange at first. In any field, with experience, professionals develop intuition and an ability to understand projects to a greater degree than those not involved with project development and delivery. This experience and intuition is extremely valuable –in a risk workshop forum we surround ourselves with "wise counsel" to seriously and thoroughly discuss the project. It might be helpful to examine the word "guess" and compare it to other words such as 'discernment' and 'judgment' that more appropriately describe risk assessment. The definitions in the following table come from the Merriam-Webster Online Dictionary/Thesaurus (with edits).

Discernment

1: The quality of being able to grasp and comprehend what is obscure **:** skill in **discerning** (insight and understanding); the process of forming an opinion or evaluation by discerning and comparing **b:** an opinion or estimate so formed; the capacity for judging; the exercise of this capacity.

Synonyms Perception, Penetration, Insight, Acumen, Perception, Penetration, Insight, and Acumen mean a power to see what is not evident to the average mind. DISCERNMENT stresses accuracy; PERCEPTION implies quick discernment; PENETRATION implies a searching mind that goes beyond what is obvious or superficial; INSIGHT suggests depth of discernment coupled with understanding; ACUMEN implies characteristic penetration combined with keen practical judgment.

Judgment

a: The process of forming an opinion or evaluation by discerning and comparing

b: An opinion or estimate so formed; a formal utterance of an authoritative opinion; a position arrived at after consideration; an idea that is believed to be true or valid without positive knowledge; an opinion on the nature, character, or quality of something

Guess

To form an opinion from little or no evidence

Synonyms assume, conjecture, presume, speculate, suppose, surmise, suspect, suspicion

Related Words gather, infer; hypothesize, theorize; believe, conceive, expect, imagine, reckon

Decision

The act or process of deciding b**:** a determination arrived at after consideration **:** <make a decision>; report of a conclusion

A position arrived at after consideration <after much deliberation, we made a decision about what to use for an estimated unit price>

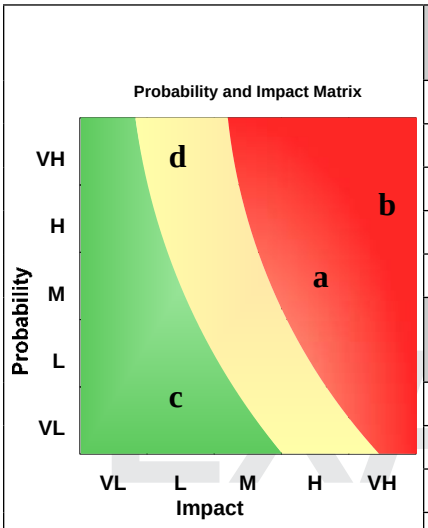
Synonyms conclusion, determination, diagnosis, judgment, resolution, verdict.

Related Words mandate, finding, ruling, sentence; choice, option, selection

EXAMPLE (depicts a simple list of risks evaluated and ranked qualitatively)

Qualitative Risk List

count	T/O	RBS #	Risk Title	Probability	Impact
a	T	ENV 30.1	Permits and Permit Appeals	Medium	High
b	T	UTL 20.1	Unidentified Utility Conflicts	High	Very High
c	T	STG 20.4	Change to Substructure Assumptions	Very Low	Low
d	T	ROW 40.1	Managed Access challenge	Very High	Low



Probability (Likelihood)	Synonyms		[1]Approximate %
Very high	Almost certain	Very Sure	≥ 90%
High	Likely	Pretty Sure	80%
Medium	Possible	Maybe	50%
Low	Unlikely	Seldom	20%
Very Low	Rare	Improbable	≤ 10%
Consequence (Impact)	**Synonyms**		**[1]Approximate % of Phase (PE, RN, CN)**
Very high	Very Critical	Very Strong	≥ 10%
High	Critical	Strong	8%
Medium	Moderate	Average	4%
Low	Slight	Mild	2%
Very Low	Very Little	Very Mild	≤ 1%

[1]Suggested percentages; project teams may adjust if they desire.

EXAMPLES ONLY

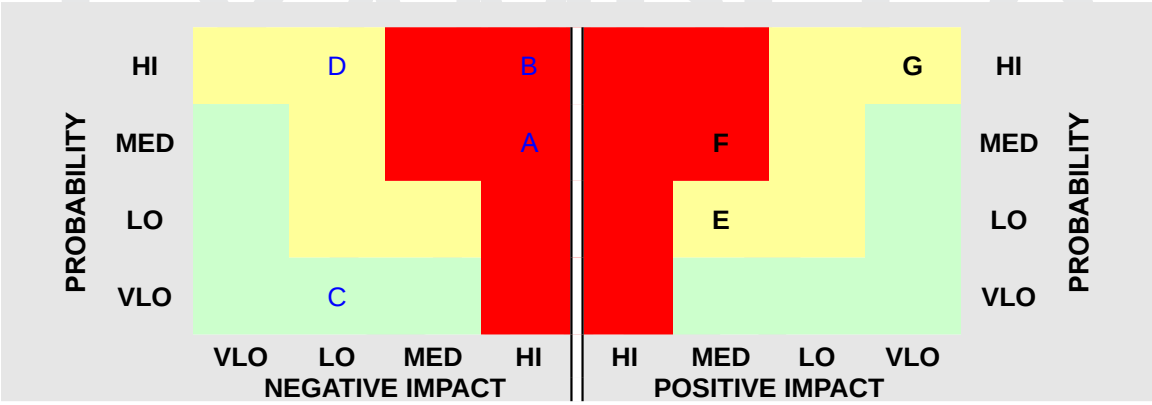
Probability Impact Matrix (5 X 5)
Figure 3-1

Qualitative Risk List (ranked based on qualitative risk analysis)

rank	count	T/O	RBS #	Risk Title	Probability	Impact
2	a	T	ENV 30.1	Permits and Permit Appeals	Medium	High
1	b	T	UTL 20.1	Unidentified Utility Conflicts	High	Very High
4	c	T	STG 20.4	Change to Substructure Assumptions	Very Low	Low
3	d	T	ROW 40.1	Managed Access challenge	Very High	Low

Qualitative Risk List (threats and opportunities)

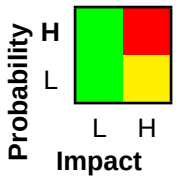
count	T/O	RBS #	Risk Title	Probability	Impact
A	T	ENV 30.1	Permits and Permit Appeals	Medium	High
B	T	UTL 20.1	Unidentified Utility Conflicts	High	High
C	T	STG 20.4	Change to Substructure Assumptions	Low	Low
D	T	ROW 40.1	Managed Access challenge	High	Low
E	O	CNS 30.1	Negotiate Better Work Windows	Low	Medium
F	O	CNS 50.1	Able to salvage some material for $	Medium	Medium
G	O	DES 10.1	Opportunity to switch to ACP (HMA)	High	High



EXAMPLES ONLY

Probability Impact Matrix (Double 4 X 4)
Figure 3-2

A simple matrix, provided below, suitable for smaller, less complex or routine projects, it also appears in the Project Management Online Guide.

	High (probability): more likely than not to happen. High (impact): Substantial impact on cost, schedule, or technical. Substantial action required to alleviate issue.
	Low (probability): less likely than not to happen. Low (impact): Minimal impact on cost, schedule, or technical. Normal management oversight is sufficient.

Project Management Online Guide is found at:
www.wsdot.wa.gov/projects/projectMgmt/Process

Project Title EXAMPLE for Risk Management Document
Project PIN # #######
Date Feb 31, 2929
Project Mngr Mgr Name **Telephone Number** (xxx) xxx-xxxx

PROJECT RISK MANAGEMENT PLAN

	Risk Identification								Qualitative Analysis			Risk Owner	Risk-Response Strategy		Monitoring and Control	
Priority	Status	ID #	Date Identified Project Phase	Risk Event (threat/opportunity)	SMART Column	Risk Trigger	Impact Area	Affected MDL/WBS Level 2 process	Probability	Impact	Risk Matrix		Strategy	ACTION TO BE TAKEN (include advantages and disadvantages)	Status Interval or Milestone Check	Date, Status and Review Comments
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Instructions	**Active**=actively monitored & controlled **Dormant**=risk is not currently a high priority, but may become active in the future. **Retired**=no longer a threat to project objectives.	**E1**	For example: 6/30/99 Scoping	Risk is an uncertain event or condition that, if it occurs, has a positive (opportunity) or negative (threat) on a project. For example; Wetland Mitigation requires additional R/W.	Detailed description of the risk. Includes information on the risk that is **Specific, Measureable, Attributable, Relevant** and **Timebound**. Describe the consequences of the risk to scope, schedule, budget or quality.	Triggers are indications that a risk has occurred or is about to occur. Used to determine when to implement the Risk Response Strategy. For example: Wetland impact is greater than 1/2 acre.	Is the primary impact to the scope, schedule, or budget?	Which WBS element will be modified as part of the response strategy? For example: PC-19 Environmental Permits	Assessment of the likelihood of occurrence. Valid entries are Low or High.	The severity of the risk's effect on the projects objectives. Valid entries are Low or High.	**High**: Substantial impact on cost, schedule, or technical. Substantial action required to alleviate issue. **Low**: Minimal impact on cost, schedule, or technical. Normal management oversight is	Name of the person or office responsible for managing the risk event.	Avoidance Transferance Mitigation Acceptance (See PM Online Guide for strategy definitions.)	Develop options and determine actions to be taken in response to the risk event. Immediate action may be required at the time of identification. Estimate value of risk and estimate cost to respond.	For example: Completion of wetland delineation expected: 2/28/00	For example: Last status update 4/30/00. Wetland delineation completed 3/15/00. Over 1 acre of wetland was delineated, action is being taken to expedite meetings with regulatory agencies & expedite the effort to provide appropriate wetland mitigation & attain project permits.
	Active	**UTL 20.1**	mm/dd/yyyy Design/PS&E	Threat - Unknown utility impacts (MP 14.7 to MP 19.4).	Areas outside of WSDOT R/W have not been investigated for utilities conflicts; Additional work is required for sewer/stormwater for Smalltown, additional investigation required for water, gas, power, fiber optic, telecommunications, etc.	Multiple Triggers: If found toward the end of design phase may require additional design work and/or R/W acquisition. If found during construction could potentially stop work.	Scope	WBS 185 Prepare Base Maps and Plan Sheets	Low	High	Probability H L / X / L H Impact	Ms. Eunice Utility	**Mitigation**	Begin subsurface utility investigations immediately. Assign team member to this issue full time until we are confident all utilities have been identifed.	Next check is at QPR on 11/20/2008	
	Active	**ENV 90.3**	mm/dd/yyyy Design/PS&E	Threat - Noise Wall	May be required to buid a permanent noise wall pending results of Type 1 Analysis.	Resutls of Type 1 Analysis will indicate the level of Noise mitigation required.	Scope	WBS 165 Perform Environmental Studies and Prepare Draft Environmental Document (DED)	High	High	Probability H L / X / L H Impact	Mr. Noiseman	**Mitigation**	Press for results of noise analysis ASAP. This is a high probability/high impact threat. Carry design as if the noise wall is going to be built (to minimize future rush design work).	Analysis is due 9/30/2008	
	Active	**ENV 40.4**	mm/dd/yyyy Construction	Threat - Cultural Resources may be encountered on D Island	During clearing and grubbing there is a potential for finding historical artifacts, particularly on the northside of D Hill near the water.	Trigger during Design: Archival and/or field investigation reveals artifacts on site. Trigger during CN: Discovery of indicator items and/or artifacts during clearing/grubbing.	Scope	WBS 185 Prepare Base Maps and Plan Sheets	Low	Low	Probability H L / X / L H Impact	Mr. History	**Acceptance**	Numerous construcion work in and around the area has occurred in the past. No artifacts have been found.	Supplmental Field investigation report due: 11/1/2008	

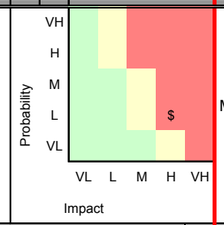
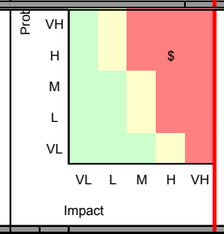
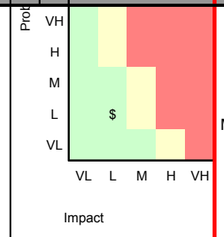
http://www.wsdot.wa.gov/Projects/ProjectMgmt/OnLine_Guide/Phase_Guides/Pre-Construction/PC_Plan_the_Work/PC_Plan_Risk.htm

EXAMPLE OF QUALITATIVE ANALYSIS WITH A 2X2 RISK MATRIX

Simplified Risk Management Plan Spreadsheet with 2×2 Probability Impact Matrix
Figure 3-3

Project Title EXAMPLE for Risk Management Document
Project PIN # #######
Date Feb 31, 2929
Project Mngr Mgr Name **Telephone Number** (xxx) xxx-xxxx

PROJECT RISK MANAGEMENT PLAN

	Risk Identification								Qualitative Analysis			Risk Owner	Risk-Response Strategy		Monitoring and Control	
Priority	Status	ID #	Date Identified Project Phase	Risk Event (threat/opportunity)	SMART Column	Risk Trigger	Impact Area	Affected MDL/WBS Level 2 process	Probability	Impact	Risk Matrix		Strategy	ACTION TO BE TAKEN (include advantages and disadvantages)	Status Interval or Milestone Check	Date, Status and Review Comments
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Instructions	**Active**=actively monitored & controlled **Dormant**=risk is not currently a high priority, but may become active in the future. **Retired**=no longer a threat to project objectives.	**E1**	For example: 6/30/99 Scoping	Risk is an uncertain event or condition that, if it occurs, has a positive (opportunity) or negative (threat) on a project. For example; Wetland Mitigation requires additional R/W.	Detailed description of the risk. Includes information on the risk that is **Specific, Measureable, Attributable, Relevant** and **Timebound**. Describe the consequences of the risk to scope, schedule, budget or quality.	Triggers are indications that a risk has occurred or is about to occur. Used to determine when to implement the Risk Response Strategy. For example: Wetland impact is greater than 1/2 acre.	Is the primary impact to the scope, schedule, or budget?	Which WBS element will be modified as part of the response strategy? For example: PC-19 Environmental Permits	Assessment of the likelihood of occurrence. Valid entries are Low or High.	The severity of the risk's effect on the projects objectives. Valid entries are Low or High.	**High**: Substantial impact on cost, schedule, or technical. Substantial action required to alleviate issue. **Low**: Minimal impact on cost, schedule, or technical. Normal management oversight is sufficient.	Name of the person or office responsible for managing the risk event.	**A**voidance **T**ransferance **M**itigation **A**cceptance (See PM Online Guide for strategy definitions.)	Develop options and determine actions to be taken in response to the risk event. Immediate action may be required at the time of identification. Estimate value of risk and estimate cost to respond.	For example: Completion of wetland delineation expected: 2/28/00	For example: Last status update 4/30/00. Wetland delineation completed 3/15/00. Over 1 acre of wetland was delineated, action is being taken to expedite meetings with regulatory agencies & expedite the effort to provide appropriate wetland mitigation & attain project permits.
	Active	**UTL 20.1**	mm/dd/yyyy Design/PS&E	Threat - Unknown utility impacts (MP 14.7 to MP 19.4).	Areas outside of WSDOT R/W have not been investigated for utilities conflicts; Additional work is required for sewer/stormwater for Smalltown, additional investigation required for water, gas, power, fiber optic, telecommunications, etc.	Multiple Triggers: If found toward the end of design phase may require additional design work and/or R/W acquisition. If found during construction could potentially stop work.	Scope	WBS 185 Prepare Base Maps and Plan Sheets	Low	High		Ms. Eunice Utility	**Mitigation**	Begin subsurface utility investigations immediately. Assign team member to this issue full time until we are confident all utilities have been identifed.	Next check is at QPR on 11/20/2008	
	Active	**ENV 90.3**	mm/dd/yyyy Design/PS&E	Threat - Noise Wall	May be required to buid a permanent noise wall pending results of Type 1 Analysis.	Resutls of Type 1 Analysis will indicate the level of Noise mitigation required.	Scope	WBS 165 Perform Environmental Studies and Prepare Draft Environmental Document (DED)	High	High		Mr. Noiseman	**Mitigation**	Press for results of noise analysis ASAP. This is a high probability/high impact threat. Carry design as if the noise wall is going to be built (to minimize future rush design work).	Analysis is due 9/30/2008	
	Active	**ENV 40.4**	mm/dd/yyyy Construction	Threat - Cultural Resources may be encountered on D Island	During clearing and grubbing there is a potential for finding historical artifacts, particularly on the northside of D Hill near the water.	Trigger during Design: Archival and/or field investigation reveals artifacts on site. Trigger during CN: Discovery of indicator items and/or artifacts during clearing/grubbing.	Scope	WBS 185 Prepare Base Maps and Plan Sheets	Low	Low		Mr. History	**Acceptance**	Numerous construcion work in and around the area has occurred in the past. No artifacts have been found.	Supplmental Field investigation report due: 11/1/2008	

http://www.wsdot.wa.gov/Projects/ProjectMgmt/OnLine_Guide/Phase_Guides/Pre-Construction/PC_Plan_the_Work/PC_Plan_Risk.htm

EXAMPLE OF QUALITATIVE ANALYSIS WITH A 5X5 RISK MATRIX

Simplified Risk Management Plan Spreadsheet with 5x5 Probability Impact Matrix
Figure 3-4

Chapter 4 Quantitative Risk Analysis

Quantitative Risk Analysis is a way of numerically estimating the probability that a project will meet its cost and time objectives. Quantitative analysis is based on a simultaneous evaluation of the impacts of all identified and quantified risks.
(WSDOT PMOG)

But to us, probability is the very guide of life. – Bishop Joseph Butler (1756)

The Strategic Analysis and Estimating Office at WSDOT offers several tools for quantitative analysis of risk. These tools are described in Executive Order 1053.00 December 10, 2008 and summarized in Table 4.1 below.

	Project Size ($)	Required Process (project managers can use a higher level process if desired)
Quantitative	$10 M to $25 M	In-formal workshop using the Self-Modeling Spreadsheet[1, 3]
	$25 M to $100 M	Cost Risk Assessment (CRA) Workshop[1, 2]
	Greater than $100 M	Cost Estimate Validation Process (CEVP®) Workshop[2]

1 In some cases it is acceptable to combine the Value Engineering Study and Risk Based Estimating Workshop.

2 Projects $25 Million and over should use the self-modeling spreadsheet in the scoping phase risk based estimating process, followed up by the more formal CRA or CEVP® process during the design phase.

3 An informal workshop is comprised of the project team (or key project team members), other participants may be included as the project manager/project team deem necessary.

NOTE: For Projects less than $10M qualitative analysis is sufficient, although a higher level may be used if desired.

Levels of Risk Based Estimating, in Support of Risk Management
Tabel 4-1

Quantitative techniques, such as Monte Carlo simulation, can be a powerful tool for analysis of project risk and uncertainty. This technique provides project forecasts with an overall outcome variance for estimated project cost and schedule. Probability theory allows us to look into the future and predict possible outcomes.

"Poor modeling can produce an output that looks convincing to managers but is so flawed that the results are dangerously misleading. On a project with unrealistically tight targets, poor risk analysis may thus become a tool that fosters management delusions about the prospects for success."

Use of quantitative analysis, while very powerful, also can be misleading if not used properly. WSDOT provides a comprehensive guide for risk workshops that, if followed, help insure a consistent process and safeguards against biased and/or misleading results. The comprehensive set of workshop guidelines are posted at:
www.wsdot.wa.gov/Projects/ProjectMgmt/RiskAssessment/workshop.htm

The following caution comes from a paper titled: "Top Down Techniques for Project Risk Management" by Martin Hopkinson presented at the 2006 PMI Conference in Madrid.

Project Risk Management is an integral component of ongoing Project Management.

Project Managers sometimes ask "when is the best time to conduct a CRA or CEVP workshop?" This is answered by reviewing the status of Project Development. When a Project Management Plan is being developed and is kept current (appropriate to the level of project development) with a well-written scope that can be communicated and comprehended, along with the associated schedule and cost estimate a project team can begin in earnest preparing for their risk management workshops.

When preparing materials and planning for a workshop that includes quantitative analysis be sure to contact the Strategic Analysis and Estimating Office of WSDOT, CREM Unit and they can help guide you through the process, including scheduling consultants and WSDOT resources to effect the completion of a quantitative analysis, either through the workshop process or use of the self-modeling spreadsheet.

When a project team prepares for a workshop much of the work that is performed on a daily or regular basis becomes the input for the analysis. This includes scope or work, schedule estimate (with backup and assumptions), cost estimate – including the basis of estimate, assumptions and backup information. Estimates are used to make financial decisions hence in order to facilitate this materials should be developed that result in and informed decision-making process; CPMS data requirements are listed in Table 4-1.

Project teams must provide specific data to the region program management office for inclusion into CPMS and the Transportation Executive Information System (TEIS). The required data is:
1. Project scheduling data for the following milestone dates: • Project definition completion date • Date for the beginning of preliminary engineering • Completion date for the environmental document • Start date for the acquisition of right of way • Date of right of way certification • Project advertisement date • Date project is operationally complete (substantially complete)
2. Estimated Project Cost Data (in Current Year Dollars, CY$) • Date of estimate basis (i.e., "March 2008 $") • Design cost estimate • Right of way cost estimate • Construction cost estimate
3. CPMS will be modified to calculate the midpoint for construction phases using the project award date and the operationally complete date.

CPMS Data Requirements
Table 4-1


Quantitative
Risk
Analysis
"How To"

How to perform Quantitative Risk Analysis

General Process

Once risks are identified and have been screened via qualitative analysis, they can be analyzed quantitatively. Recall that identification includes a thorough description of the risk and risk triggers. With quantitative analysis the probability of occurrence and consequence if the risk event occurs must also be documented. Figure 4-1 depicts the workshop process.

Tools and Techniques

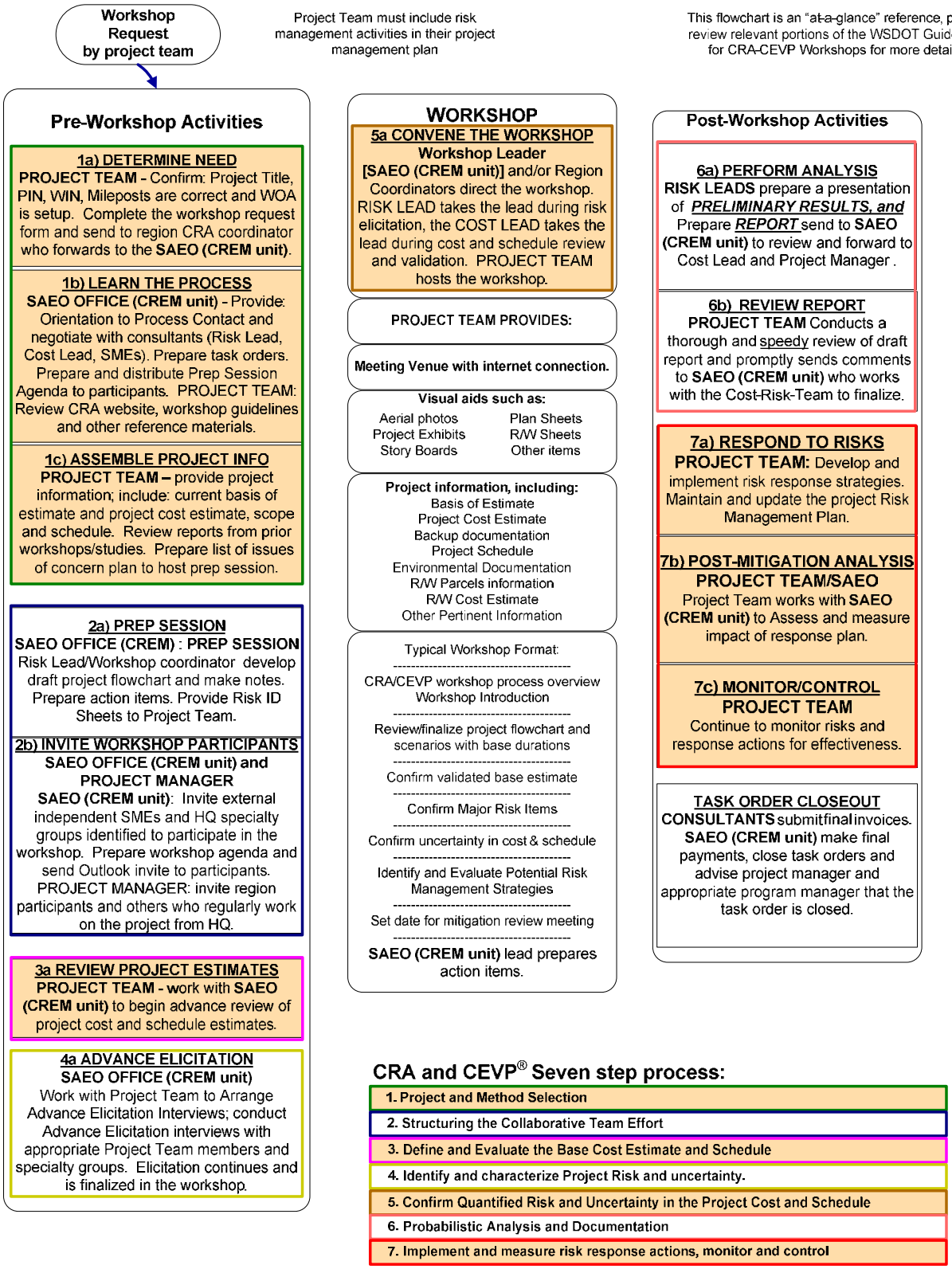
1 Gather and Represent Data
   - Interviews – can be formal or informal settings, such as smaller group meetings and/or larger formal workshops.
   - Subject Matter Expert input – participating collaboratively with the project team and cost-risk team can participate in interviews or contribute opinions in other ways such as surveys (questionnaires).
   - Represent data in terms of probability and impact, impacts can be represented using discrete distributions or continuous distributions.

2 Quantitative Risk Analysis and Modeling
   - Project simulation using Monte Carlo technique to generate a probability distribution of project cost and schedule based on uncertainty and risk effects.

Quantitative Risk Analysis Outputs

1 Risk Register – the risk register begins during Risk Identification and is further developed during analysis (qualitative and/or quantitative); the risk register is a key component of the project management plan.
   - Prioritized list of quantified risks – those risks that have the most significant impact (threats or opportunities) to project objectives. (tornado diagrams, expected values, decision trees)
   - Probabilistic analysis of the project. Estimated cost and completion dates and associated confidence levels.
   - Quantitative analyses can be conducted several times throughout project development; trends can be identified, mitigation strategies can be implemented and monitored, the risk profile of a project evolves and changes as the project is developed and knowledge is gained and design changes occur.

Informal Workshop (Meeting)
For smaller projects an informal workshop comprised of the project team and/or key project team members, and other participants (such as specialty groups involved with critical items) may suffice.



Workshop Process for CRA or CEVP

Figure 4-1

Risk management is ongoing and iterative, periodically workshop members can regroup to evaluate the project and associated uncertainty and risks, **workshops typically occur for a project every 12 to 24 months or at key project milestones**. Project risks and mitigation efforts should be discussed at regular project meetings, make changes as appropriate and following those changes re-run the risk model. Value is gained when action is taken to respond to risks resulting in a cost and schedule savings to the project.

In order to fully understand our project we must determine what we know and what we do not know about a project. In our industry, Civil Engineering – Transportation, we have devoted a good deal of resources to clearly explain **what is known** of a project, we have many specialty offices that gather and provide data in support of project delivery, including: aerial photography, surveying, site investigations, bid histories, real estate services, right-of-way, access management, utilities, environmental, hydraulics, structures, geotech, railroad, tribal liaison office, planning and programming, ad/bid/award, construction, tolling, economic, programming external resource agencies and stakeholders, public interest groups, and others. Just as important is to **devote some energy and resources to assess what is not known** and/or is uncertain about a project, one tool for accomplishing this is intentional, thoughtful and deliberate project risk management –as part of an overall project management plan.

Risk assessment is not a measure of estimate accuracy:

The project team must examine each critical item and predict its possible extreme values considering all risks, including compounding effects. It is important to understand that the range,as considered in this method, is not the expected accuracy of each item. ***This is a key issue.*** *Risk analysis is not an analysis of estimate accuracy. Accuracy is dependent upon estimate deliverables and estimate maturity.*
AACE International Recommended Practice No. 41R-08 **RISK ANALYSIS AND CONTINGENCY DETERMINATION USING RANGE ESTIMATING** TCM Framework: 7.6 – Risk Management June 25, 2008

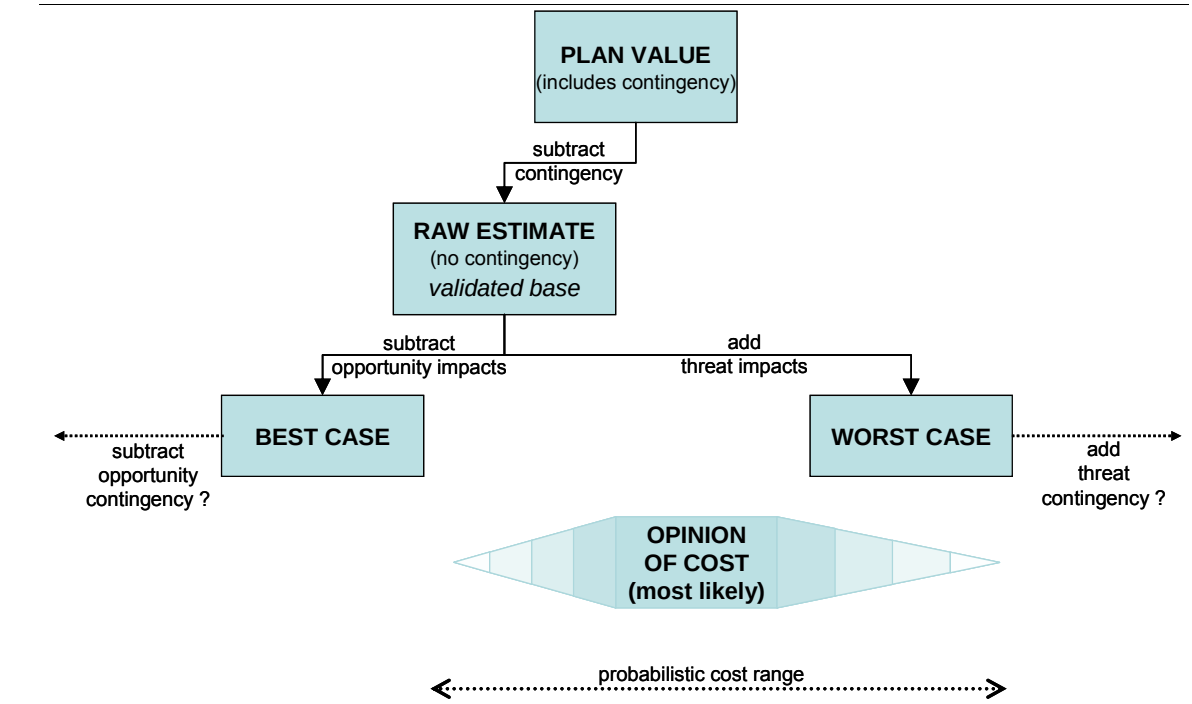
Risk management must be partnered with a well-organized and properly documented project base cost estimate. Risk management introduces reality into our project management process by recognizing that every project has a risk of cost overrun – this does not mean cost overrun is inevitable – it means it is possible.

In the book titled "Project Risk Management" by Chris Chapman and Stephen Ward there is an acronym presented to describe a Risk Management Process framework for projects, the acronym is SHAMPU which refers to: **S**hape, **H**arness, **A**nd **M**anage **P**roject **U**ncertainty. There are some helpful ideas expressed via this acronym and they are presented here from page 58 of the above referenced book.

Detailed steps of process	Mid level portrayal	Simplest portrayal
define the project **focus** the process	clarify the **basis of analysis**	**shape** the project strategy
identify the issues **structure** the issues clarify **ownership**	execute the **qualitative analysis**	
estimate variability **evaluate** implications	execute the **quantitative analysis**	
harness the plans	**harness** the plans	**harness** the plans
manage implementation	**manage** implementation	**manage** implementation

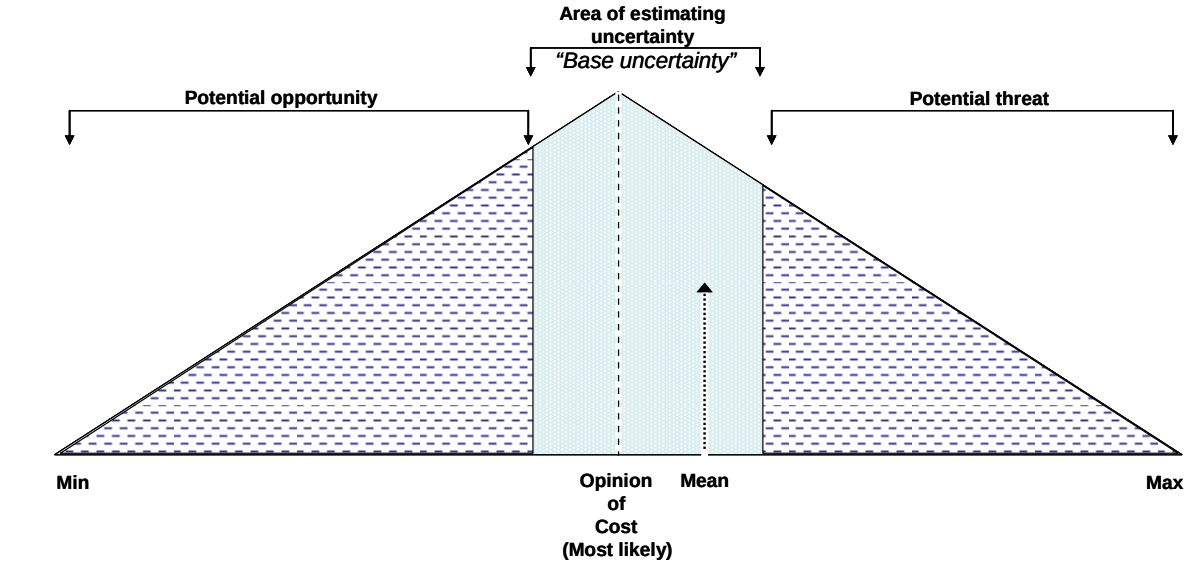
SHAMPU process in 3 levels of detail
Table 4-3

Figure 4-2 is a schematic of how an estimate range emerges from a risk based estimating process. The first estimate, or "plan value", provided by the project team often will contain contingencies (explicit and/or implicit) within the estimate; the first step is to review the estimate and remove the contingencies and making any needed corrections that are identified. Figure 4-3 depicts the regions of an estimate.



Credit: David Hillson, Effective Opportunity Management for Projects

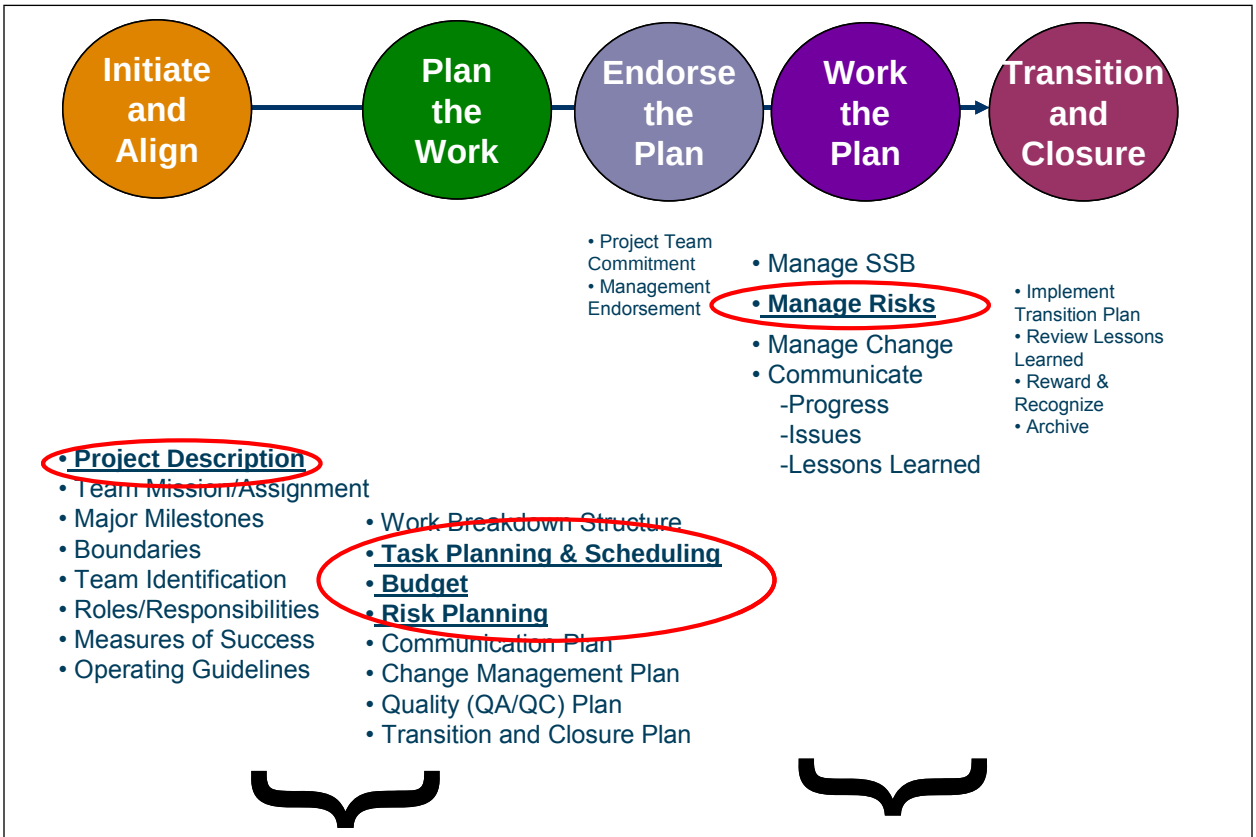
Creating a probabilistic estimate
Figure 4-2



Credit: David Hillson, Effective Opportunity Management for Projects

Regions of an estimate
Figure 4-3

Quantitative analysis is a natural activity that fits into our standard project management process, and unfolds something like this:



IDENTIFY and ANALYZE Risk

Project Description: subject of the risk assessment

Task Planning & Scheduling Budget	This produces a project estimate and schedule.

Risk Planning:
The project team, as part of their normal project development and project management activities needs to include activities for risk management in its work plan.

The team prepares a project estimate based on what is known about the project at that time; the estimate reflects the project if things go per the project plan. Uncertainty and risk events are identified and characterized.

RESPOND, MONITOR and CONTROL Risk

Risk Management is an integral component of day-to-day project management. Project teams implement and continuously upgrade the Risk Management Plan throughout the project. Primary Risk Management functions include:

- Monitor risks (threats and opportunities)
- Identify new risks
- Evaluate/update probability of occurrence and potential impacts
- Devise and implement response strategies
- Evaluate and document effectiveness of response
- Report to Management and Stakeholders

Risk Management, a part of Project Management
Figure 4-4

Chapter 5 Risk Response

Take action in response to identified risks. Following identification and analysis of project risks project managers and project teams must take action in response to the identified project risks, focusing on risks of most significance, in order to shift the odds in favor of project success.

Early in project development, activities and information can seem chaotic and comes to us from multiple directions and multiple sources, risk management provides a structured and disciplined way to document the information, evaluate and analyze the information, and emerge with a well-organized and prioritized list of project risks. This prioritization rescues us from indecision with information we can use to direct our project risk management resources.

In order to maximize the benefits of project risk management we must incorporate the project risk management activities into our project management plan and work activities. This means building risk management activities into our Work Breakdown Structure (WBS); WSDOT has a ready made WBS in the form of its Master Deliverables List (MDL) to help insure our project workplans are comprehensive, consistent and complete. Recall the Risk Management steps include: Risk Management Planning, Risk Identification, Qualitative Risk Analysis, Quantitative Risk Analysis, Risk Response, Risk Monitoring and Control.

Risk Response requires effort to develop and implement response actions; we must plan for expending this effort following the results of our risk analysis. To this end we have a number of tools readily available, including the Risk Management Planning Spreadsheet found at: www.wsdot.wa.gov/Projects/ProjectMgmt/RiskAssessment/

Descriptions of risk response actions follow:

Actions in response to risks:

Threats	Opportunities
1. Avoid	1. Exploit
2. Transfer	2. Share
3. Mitigate	3. Enhance
4. Accept	

Risk Response: Actions

AVOID (***threats***)

Avoidance actions include: change project management plan to eliminate a threat, to isolate project objectives from the risk's impact, or to relax the project objective that is in jeopardy, such as extending schedule or reducing scope. Some risks that arise early in the project can be avoided by clarifying requirements, obtaining information, improving communication, or acquiring expertise.

PMBOK

Action taken to insure the probability or impact of a threat is eliminated.

Two types of action 1) remove the cause of the risk (risk trigger); 2) execute project in different way while still aiming to achieve project objectives. Not all risks can be avoided or eliminated, and for others this approach may be too expensive or time-consuming, but this should be the first strategy considered for each risk.

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EXPLOIT (opportunities)

Action taken to insure the benefit of an opportunity is realized.

Opposite of avoid – this strategy is to insure a positive impact, an opportunity is realized. Taking action to make the opportunity definitely happen, such response actions include: assigning more talented resources to a project to reduce time to completion, and/or to provide better quality than originally planned.

PMBOK

Eliminate the uncertainty associated with a particular upside risk. An opportunity is defined as a risk event that if it occurs will have a positive effect on achievement of project objectives. Avoid and Exploit is the most aggressive of the response strategies and should be reserved for those “golden opportunities” with high probability and impacts.

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TRANSFER (threats)

Action to allocate ownership for more effective management of a threat.

Transferring a threat does not eliminate it; the threat still exists however it is owned and managed by another party. Transferring risk can be an effective way to deal with financial risk exposure. Transferring project risk almost always involves payment of a risk premium to the party taking the risk, examples include: insurance, performance bonds, warranties, etc. Contracts may be used to transfer specified risks to another party.

PMBOK

Transferring risk involves finding another party who is willing to take responsibility for its management, and who will bear the liability of the risk should it occur. The aim is to ensure that the risk is owned and managed by the party best able to deal with it effectively. Risk transfer usually involves payment of a premium, and the cost-effectiveness of this must be considered when deciding whether to adopt a transfer strategy.

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SHARE (opportunities)

Action to share with a third party; enhance/exploit opportunity.

Sharing a positive risk involves allocating ownership to a third party who is best able to capture the opportunity for the benefit of the project. Examples of sharing actions include forming risk-sharing partnerships, teams, or joint ventures, which can be established with the express purpose of managing opportunities.

PMBOK

Allocating risk ownership for an opportunity to another party who is best able to handle it, in terms of maximizing probability of occurrence and increasing potential benefits if it does occur. Transferring threats and sharing opportunities are similar in that a third party is used, those to whom threats are transferred take on the liability and those to whom opportunities are allocated should also be allowed to share in the potential benefits.

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MITIGATE – or reduce (threats)

Action taken to reduce the probability and/or impact of a threat.

Risk mitigation implies a reduction in the probability and/or impact of an adverse risk event to an acceptable threshold. Taking early action is often more effective to repair than trying to repair the damage after the risk has occurred. Examples of mitigation strategies include: adopting less complex processes, conducting more tests and/or field investigations, developing a prototype; measures to address impact include: targeting linkages that determine the severity, such as designing redundancy into a subsystem may reduce the impact from a failure of the original component.

PMBOK

Mitigation or acceptance or the strategies most often used since the number of threats that can be addressed by avoidance or transfer are usually limited. Preventive responses are better than curative responses because they are more pro-active and if successful can lead to risk avoidance. Preventive responses tackle the causes of the risk; where it is not possible to reduce probability a mitigation response should address the adverse impact, targeting the drivers that determine the extent of the severity.

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ENHANCE (opportunities)

Action to enhance opportunity.

This response modifies the "size" of an opportunity by increasing probability and/or impact. Seeking to facilitate or strengthen the cause of the opportunity, and proactively targeting and reinforcing its trigger conditions. Impact drivers can also be targeted, seeking to increase the project's susceptibility to the opportunity.

PMBOK

This response aims to modify the "size" of the positive risk. We enhance the opportunity by increasing the probability and/or impact of an opportunity thereby maximizing benefits realized for the project. If the probability can be increased to 100% this is effectively an exploit response.

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ACCEPT

Action taken to document the acceptance of the risk.

The term "accept" refers to risks that remain after response actions and/or for which response is not cost effective are accepted; risks that are uncontrollable (no response actions are practical) are also accepted.

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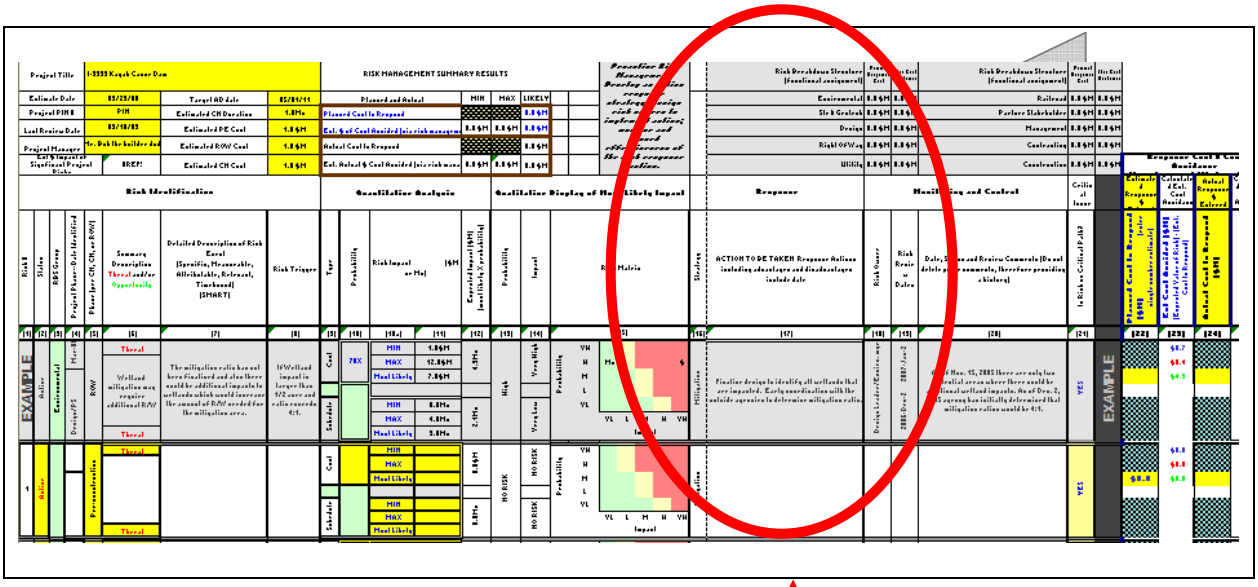
Ultimately it is not possible to eliminate all threats or take advantage of all opportunities –we can document them and at least provide awareness that these exist and have been identified, some term this 'passive acceptance'. In some cases, in some industries, a contingency reserve is established to deal with the aggregate residual risk that has been accepted, some term this 'active acceptance'.

As we continue through project development the project risk profile will change. Typically as we successfully respond to risks and our project knowledge increases our risk exposure will diminish. In effect we can retire risk reserve as risk events are successfully avoided or mitigated or we have passed the time during which the risk is active and it becomes retired.


Risk Response
"How to"

Risk Management Planning Spreadsheet
(www.wsdot.wa.gov/Projects/ProjectMgmt/RiskAssessment)



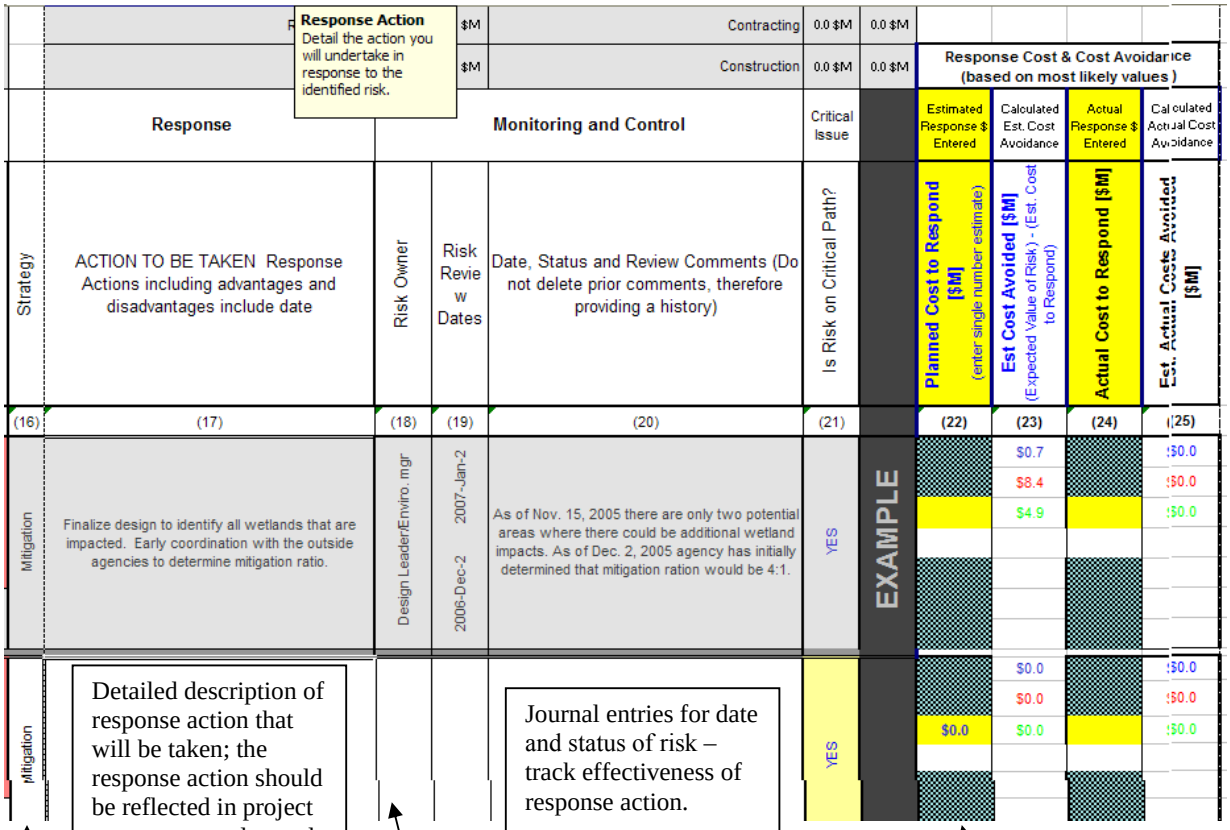
Risk Identification	Risk Analysis	Risk Response	Monitor and Control
(description/trigger)	(quantitative/qualitative)	(actions, owner, date)	(status, updates, results)

Next page zooms in on this section.

IN THIS CHAPTER WE FOCUS ON RESPONSE

Risk Management & Planning Spreadsheet
Figure 5-1

Type of Response action



Type of Response action

Threats	Opportunities
Avoid	Exploit
Transfer	Share
Mitigate	Enhance
Accept	

RMP Spreadsheet: Response
Figure 5-2

Risk Response Tools and Techniques

After we have identified and analyzed the risks we know where to focus our efforts. The output from the analysis provides a ranked risk register with the risks of greatest significance to project objectives determined. Apt response actions to significant risks must be cost effective and realistic.

Critical risks must be met with vigorous response actions, lower ranking risks should receive response actions commensurate with their significance.

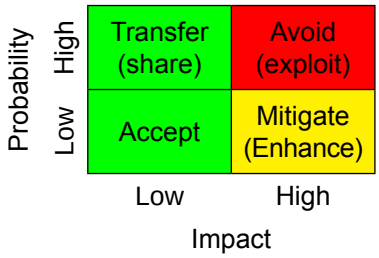
Documentation of Response Actions

Document the response action by describing the action, which work activities it will affect and the cost of the response action. Identify the person(s) responsible for successful implementation of the response action. Also consider the time impacts of the response action and how the risk response may affect the overall project and/or other risks.

Planning Risk Response Actions

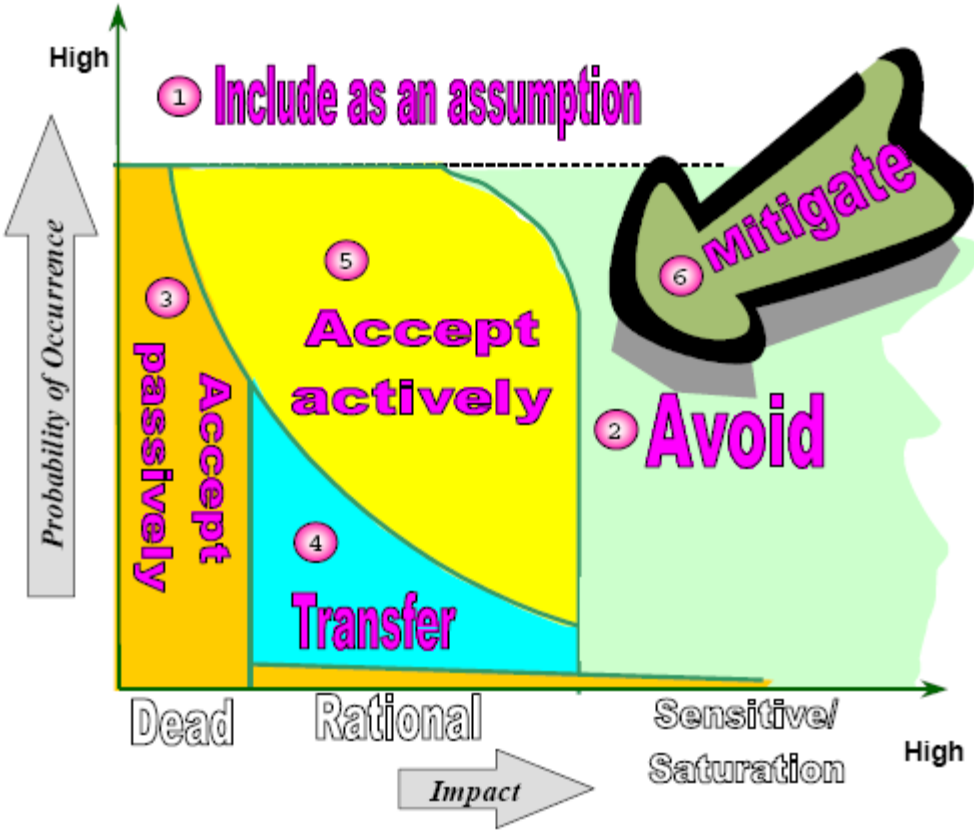
- **Select a response action** - the action selected is influence by the level of the risk consider the figure below:

High impact and high probability risks require aggressive responses (threats should be avoided and opportunities exploited if possible).



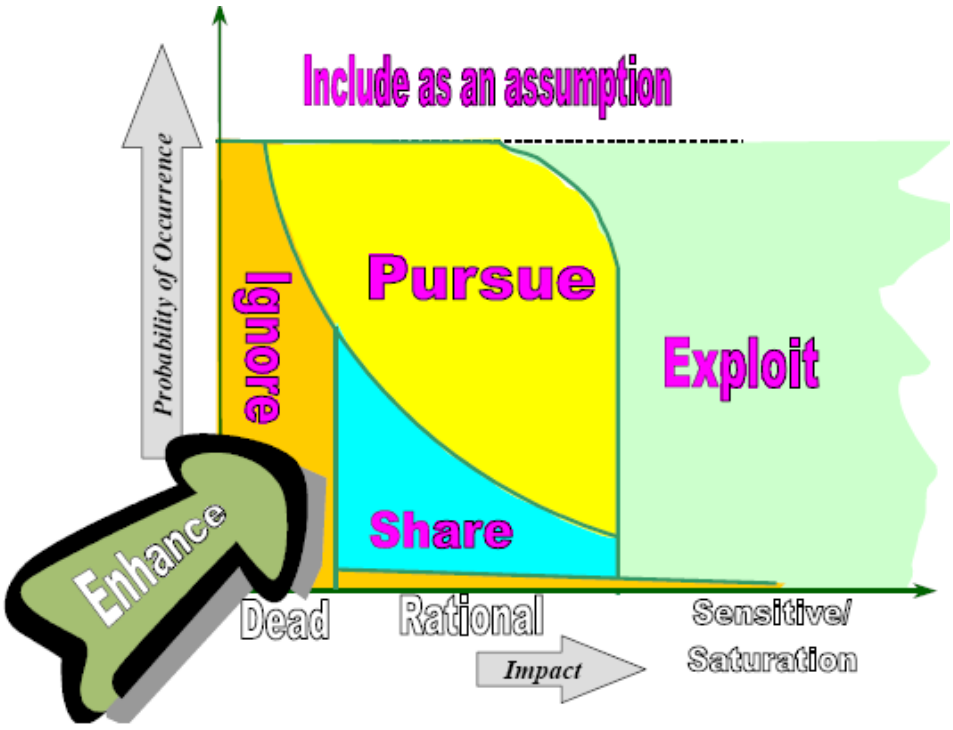
Simple Response Matrix
Figure 5-3

The next two figures on the following pages depict typical response actions for threats and for opportunities depending on the region of probability and impact the risk resides.



1. If a risk has an extremely high probability of occurrence, it may be best to assume the condition as part of the base.
2. Risks (threats) with high impacts, can over a given limit, wreck a project; these risks must be avoided.
3. Insignificant risks can be accepted, passive response.
4. Between avoidance and acceptance we can take other actions such as mitigation or for risks with low probabilities we may want to transfer them.
5. For risks (threats) above a certain probability we may choose to accept actively by mitigating and/or preparing contingency plans in the event of its occurrence.
6. All risks (threats) should be mitigated where practical and cost-effective.

Typical Risk Response Planning Chart for Threats
Risk Response Planning: Selecting the Right Strategy Piney (2002)
Figure 5-4



1. If a risk has an extremely high probability of occurrence, it may be best to assume the condition as part of the base.
2. Risks (opportunities) with high impacts; these risks should be exploited.
3. Insignificant risks can be accepted, passive response.
4. Between exploit and accept we can take other actions such as enhance and/or share opportunity risks.
5. Risks (opportunities) above a certain probability we may choose to accept actively by preparing plans in the event of its occurrence –how will we take advantage of a fortunate occurrence?
6. All risks (opportunities) should be enhanced where practical and cost-effective.

Typical Risk Response Planning Chart for Opportunities
Risk Response Planning: Selecting the Right Strategy Piney (2002)
Figure 5-5

Recall the Identified Risk (compare pre-mitigated to mitigated)

Project Title:
Project Manager:
Date Risk Identified:

CN Duration Estimate
PE Estimate
RW Estimate
CN Estimate

Risk ID Sheets.xls

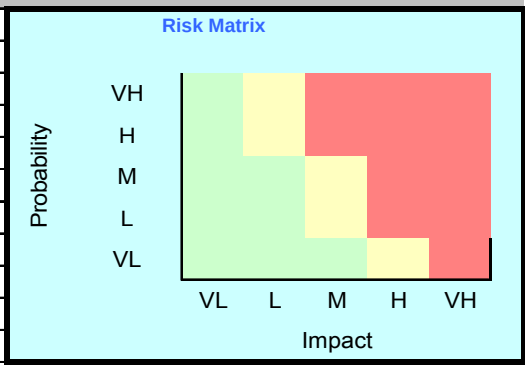
Pre-mitigated or Post mitigated ?

Parameters for Monte-Carlo Modeling

Risk #	Status	Dependency	Project Phase	Summary Description Threat and/or Opportunity	Detailed Description of Risk Event (Specific, Measurable, Attributable, Relevant, Timebound) [SMART]	Risk Trigger	Type	Probability Correlation	Risk Impact ($M or Mo)	
(1)	(2)	(3)	(5)	(6)	(7)	(8)	(9)	(10)	[10a]	(11)
1	Retired		Construction	*Threat*			Cost		MIN	
									MAX	
									Most Likely	
							0		Master Duration Risk	
				Threat			Schedule		MIN	
									MAX	
									Most Likely	

Supplemental notes about this risk event

Risk Trigger Details:
Risk Owner:
Risk Breakdown Structure # (RBS#)
Work Breakdown Stucture # (WBS#)
Critical Path (yes or no)
Response Actions (action to be taken)



Action by date:
Status review date:
Status review date:

ADDITIONAL NOTES:

Actions to implement strategy:

What needs to be done?	Who will do it?	Due date?
Communication with parties.		
Succession plan for staff changes.		
Decisions ASAP on design elements.		

Risk ID Sheet
Figure 5-6

Chapter 6 Risk Monitoring and Control

"Control is an illusion." Some of us may have heard this phrase before; and we may have had experiences when we have felt this phrase to be very apropos – however this phrase does not tell the whole story. We may have little or no control over the external environment but we do have control over how we interact with it. We do have control over our state of readiness, we can look ahead and improvise and adapt. We can control the robustness of our response to identified risk events and the quality of our documentation. We have control over how earnestly we integrate risk management into our project management plans.

Risk Monitoring and Control

As we continue through project development the project risk profile will change. Typically as we successfully respond to risks and our project knowledge increases our risk exposure will diminish. In effect we can retire risk reserve as risk events are successfully avoided or mitigated or we have passed the time during which the risk is active and it becomes retired.

Risk Monitoring and Control Tools and Techniques

After we have implemented response actions, we must track and record their effectiveness and any changes to the project risk profile. Did the response actions have a positive or negative effect on achieving project objectives? If so explain how and why in the risk management plan.

Documentation of Response Actions

This section is devoted to measuring project risk management per performance, and determining whether a project is tracking to plan or deviating in a negative manner. This will require a blend of qualitative judgments and quantitative measures to determine the "health" of the project. Document the response action by describing the action, the work activities it will affect and the cost of the response action. Identify the person(s) responsible for successful implementation of the response action. Also consider the time impacts of the response action and how the risk response may affect the overall project and/or other risks.

Determining the appropriate metrics for the project, ensuring they are not burdensome and affect behavior. Too often, metrics change behavior to provide better metrics not better performance. Set the amounts and conditions for use of the project risk reserves. Establish the final objectives of the project with stakeholders to improve the chances of project success. Confirm endorsement of team members and stakeholders as the project plan evolves.

Monitoring and Controlling Project Risk

The project manager and project team apply their project management plan through project development and completion of their deliverables. Monitor the project status looking for trends that can indicate variations (good and bad) in the project execution. Results of the analysis need to be communicated and adjustments made through a change management and/or issue resolution process. The ability to describe the history of the project and how it evolved is essential to developing lessons learned for the future.

Helpful Hints

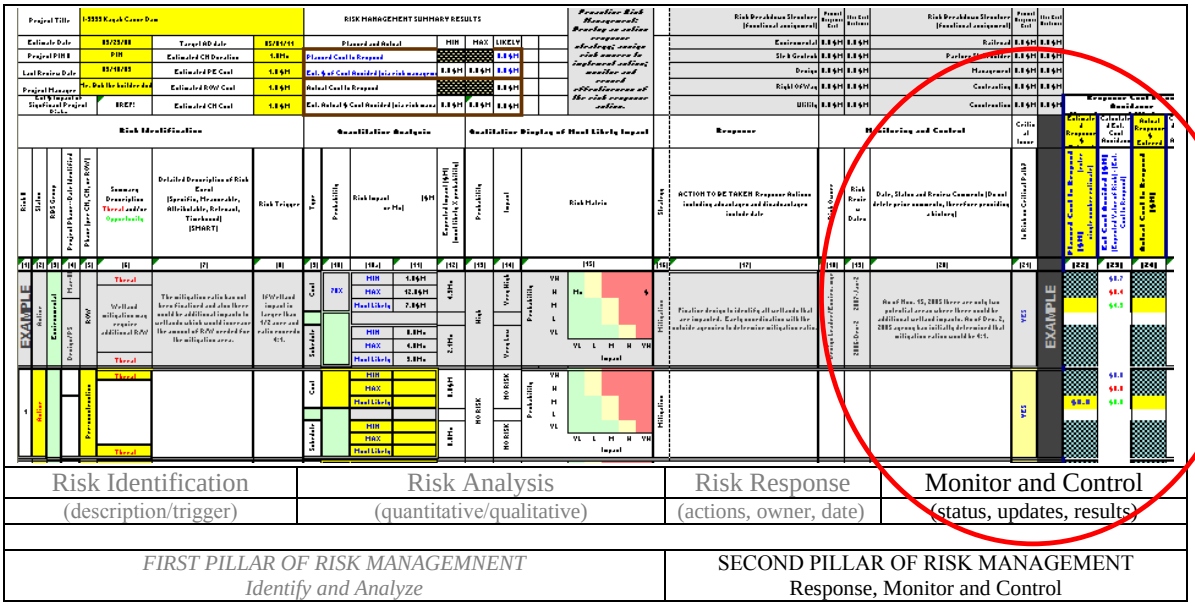
- Be thorough and tenacious in gathering status update information for risks.
- Monitor status and trends continuously (scope, schedule, cost estimates, quality of product, et al).
- Address problems and issues immediately –in fact anticipate and discuss in advance if possible.
- Communicate.


Risk
Monitoring and Control
"How to"

Risk Management Planning (RMP) Spreadsheet

(www.wsdot.wa.gov/Projects/ProjectMgmt/RiskAssessment)

Figure 6-1 depicts the RMP spreadsheet; this easy to use spreadsheet provides an effective and convenient way to summarize project risk management activities for projects that have conducted a quantitative risk analysis. The spreadsheet is typically used for the most significant risks as determined via the quantitative risk analysis, some term these risks "candidates for mitigation".



Risk Management Plan spreadsheet
Figure 6-1

Notice that the spreadsheet is conveniently arranged into four sections: 1) risk identification; 2) risk analysis; 3) risk response; and 4) monitor and control. In this chapter we focus on monitor and control.

Figure 6-2 zooms in on the second pillar of risk management, as recorded in the RMP spreadsheet, and indicates how to use the entries to document the risk response actions and their effectiveness in the monitoring and control portion of the spreadsheet.

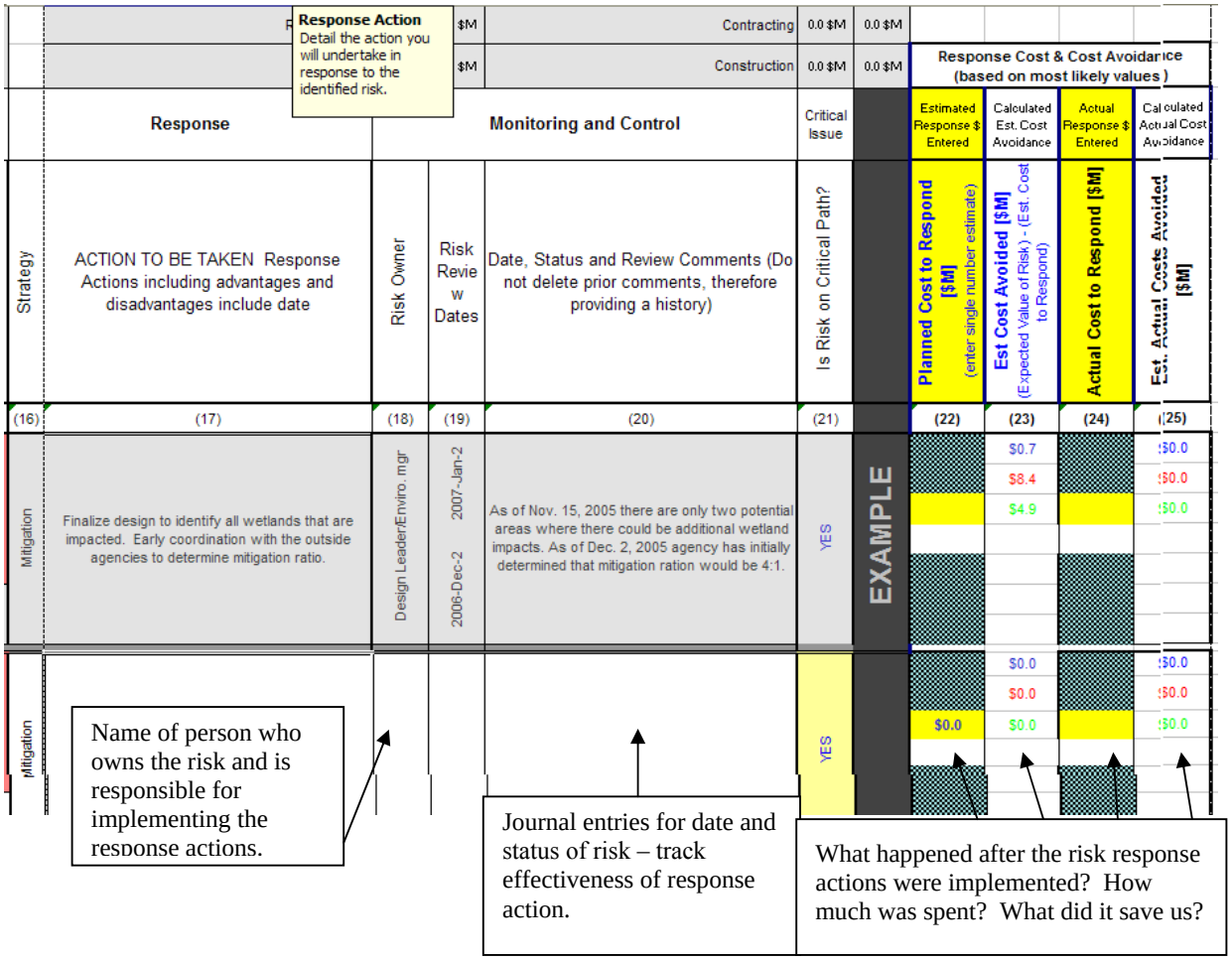


Figure 6-2

Figure 6-3 provides an example of a completed RMP spreadsheet, and the following pages, describe how to use the Risk Management Plan spreadsheet to monitor and control project risk.

Project Title	I-9999 Kayak Canoe Dam		
Estimate Date	03/30/09	Target AD date	02/21/12
Project PIN #	PIN	Estimated CN Duration	7.0Mo
Last Review Date	03/23/09	Estimated PE Cost	4.0 $M
Project Manager	Mr. Bob the builder dude	Estimated ROW Cost	12.0 $M
Est $ Impact of Signficant Project Risks	7.1$M	Estimated CN Cost	30.0 $M

RISK MANAGEMENT SUMMARY RESULTS

Planned and Actual	MIN	MAX	LIKELY
Planned Cost to Respond			0.6 $M
Est. $ of Cost Avoided (via risk management)	1.1 $M	5.2 $M	3.8 $M
Actual Cost to Respond			0.7 $M
Est. Actual $ Cost Avoided (via risk management)	1.0 $M	5.1 $M	3.7 $M

Proactive Risk Management: Develop an action response strategy; assign risk owners to implement action; monitor and record effectiveness of the risk response action.

Risk Breakdown Structure (functional assignment)	Planned Response Cost	Likely Cost Avoidance	Risk Breakdown Structure (functional assignment)	Planned Response Cost	Likely Cost Avoidance
Enviromental	0.0 $M	1.4 $M	Railroad	0.1 $M	0.5 $M
Str & Geotech	0.0 $M	0.0 $M	Partner Stakeholder	0.0 $M	0.0 $M
Design	0.0 $M	0.0 $M	Management	0.0 $M	0.0 $M
Right Of Way	0.5 $M	1.9 $M	Contracting	0.0 $M	0.0 $M
Utility	0.0 $M	0.0 $M	Construction	0.0 $M	0.0 $M

Risk Identification

Risk # (1)	Status (2)	RBS Group (3)	Project Phase--Date Identified (4)	Phase (pre CN, CN, or ROW) (5)	Summary Description Threat and/or Opportunity (6)	Detailed Description of Risk Event (Specific, Measurable, Attributable, Relevant, Timebound) [SMART] (7)	Risk Trigger (8)
1	Active	Railroad	Construction	Construction	Threat RR Coordination during Consturction Threat	Aggressive project schedule and coordination challenges with Union Pacific RR - tracks may be active during construction - causing delays.	Unresolved coordination with RR.
2	Active	Environmental	Design/PS&E	Pre-construction	Threat Permit appeal Threat	Permits appealed. Most likely to be appealed is the Type 2 Master Use Permit.	Appeal filed
3	Active	Environmental	Design/PS&E	Pre-construction	Threat Wetland Mitigation Ratio Requirement Increases Threat	Environmental agency requirements for wetland mitigation ratios may change to as great as 6:1; these changes will impact the ROW cost, and design and construction as well.	Memo from HQ to Region notifying us of the change in requiremetns.
4	Active	Right Of Way	Design/PS&E	Pre-construction	Threat R/W acquisition process will not be completed within the aggressive schedule. Threat	The R/W acquisition process may not allow projects to maintain aggressive schedule. However there may be adequate R/W in the 4-lane widening sections to result in only needing R/W at intersection locations. Env requirements may drive up the amount of parcels needed and total cost of R/W.	Project footprints identified and memo from HQ environmental.
5	Active	Management	Design/PS&E	Pre-construction	Threat Funding Delay Threat	Base assumes funding available as needed (unconstrained). Despite additional communications effort (see separate risk), public and/or legislative support and/or funding priorities may not allow for funding this project as assumed in "base" schedule > funding delay may occur.	Funding reallocation

Quantitative Analysis / **Qualitative Display of Most Likely Impact**

Risk #	Type (9)	Probability (10)	Risk Impact ($M or Mo) [10a]	(11)	Expected Impact ($M) [most likely X probability] (12)	Probability (13)	Impact (14)	Risk Matrix (15)
1	Cost	70%	MIN / MAX / Most Likely	3.0$M / 3.0$M / 3.0$M	2.1$M	High	High	Mo, $
1	Schedule		MIN / MAX / Most Likely	5.0Mo / 7.0Mo / 6.0Mo	4.2Mo		Low	
2	Cost	40%	MIN / MAX / Most Likely	1.0$M / 1.0$M / 1.0$M	0.4$M	Moderate	Moderate	$,Mo
2	Schedule		MIN / MAX / Most Likely	6.0Mo / 12.0Mo / 9.0Mo	3.6Mo		Moderate	
3	Cost	50%	MIN / MAX / Most Likely	0.2$M / 3.6$M / 2.0$M	1.0$M	Moderate	High	$
3	Schedule		MIN / MAX / Most Likely		0.0Mo		NO RISK	
4	Cost	60%	MIN / MAX / Most Likely	1.0$M / 5.0$M / 4.0$M	2.4$M	High	Very High	Mo, $
4	Schedule		MIN / MAX / Most Likely	1.0Mo / 9.0Mo / 7.0Mo	4.2Mo		Moderate	
5	Cost	40%	MIN / MAX / Most Likely	1.0$M / 9.0$M / 3.0$M	1.2$M	Moderate	High	Mo, $
5	Schedule		MIN / MAX / Most Likely	1.0Mo / 24.0Mo / 6.0Mo	2.4Mo		Low	

Risk Matrix axes: Probability (VH, H, M, L, VL); Impact (VL, L, M, H, VH).

Response / **Monitoring and Control**

Risk #	Strategy (16)	ACTION TO BE TAKEN Response Actions including advantages and disadvantages include date (17)	Risk Owner (18)	Risk Review Dates (19)	Date, Status and Review Comments (Do not delete prior comments, therefore providing a history) (20)	Critical Issue: Is Risk on Critical Path? (21)
1	Mitigation	Continued and increase negotiation with the railroads; try to establish a memorandum of understanding that will allow UP to keep some tracks inactive during construction. (this risk response action has only a minor cost)	Casey Jones	last time	As a result of implementing increased attention to negotiation with Union Pacific tracks we can now estimate that severl tracks will be inactive during construction. This will simplify construction during Stage 1 (e.g., by not having to construct under typical railroad operational windows, reduced design constraints, etc.). The full set of implications will be evaluated during the next CEVP.	YES
2	Avoidance	Negotiate with the city about the master use permit requirement.	Ms. Permit Negotiator	last time	Negotiations have concluded with a written agreement that a master use permit will not be necessary for this project.	YES
3	Mitigation	Notify upper management of this issue (so they are not surprised later if this event occurs). Monitor and prepare funds request. The advantage is that scope is preserved and we deliver what we said we would deliver; Disadvantage is that the project cannot be delivered within the current budget.	Paul Revere	last time	Draft budget impact memo has been prepared and request submitted to region program management. Awaiting a response to our request from program management.	YES
4	Avoidance	Reduce roadway footprint through use of walls, etc. Advantages include avoiding some environmental impacts and R/W needs - resuling in lower cost and schedule impacts for R/W and env. Disadvantages include increased construction costs.	John Stevens	last time	R/W plans submitted for approval parcel number is known and RES cost estimate is updated and more complete.	YES
5	Acceptance	we know this risk exists and that we have to live with it -monitor and review at project meetings; keep managers and stakeholders informed.	Bob the Builder	last time	all who attended the last proejct meeting were made aware of this situation.	YES

Response Cost & Cost Avoidance (based on most likely values)

Risk #	Planned Cost to Respond [$M] (enter single number estimate) (22) — Estimated Response $ Entered	Est Cost Avoided [$M] (Expected Value of Risk) - (Est. Cost to Respond) (23) — Calculated Est. Cost Avoidance	Actual Cost to Respond [$M] (24) — Actual Response $ Entered	Est. Actual Costs Avoided [$M] (25) — Calculated Actual Cost Avoidance
1	$0.1	$0.5 / $0.5 / $0.5	$0.2	$0.4 / $0.4 / $0.4
2	$0.0	$0.4 / $0.4 / $0.4	$0.1	$0.3 / $0.3 / $0.3
3	$0.0	$0.1 / $1.8 / $1.0	$0.0	$0.1 / $1.8 / $1.0
4	$0.5	$0.1 / $2.5 / $1.9	$0.4	$0.2 / $2.6 / $2.0
5	$0.0	$0.0 / $0.0 / $0.0	$0.0	$0.0 / $0.0 / $0.0
Total	$0.6 Estimated Cost to Respond	$1.1 / $5.2 / $3.8 Estimated Cost Avoided most likely	$0.7 Actual Cost to Respond	$1.0 / $5.1 / $3.7 Actual Cost Avoided most likely

Total Estimated Cost Impacts (min, max, most likely)	[10a]	(11) Risk Impact range ($M)
	min	$6.2
	max	$21.6
	most likely	$13.0

$7.1 **Total Estimated Expected Value of Cost Impacts (expected value = probability * most likely impact)**

NOTE: This project identified over 50 risks, 23 of which were deemed significant enough to warrant inclusion in the quantitative risk analysis model. The analysis provided a prioritized list of risks -these 5 risk events emerged as the candidates for mitigation the project manager chose to focus on. The other 40+ risks were not simply ignored, they provided "issues awareness" for various specialty groups and were dealt with as each specialty group deemed appropriate for relevant risks; the other risks serve as a "watch list" for the project.

www.wsdot.gov/projects/projectmgmt/riskassessment

Risk Management Plan spreadsheet (completed)
Figure 6-3

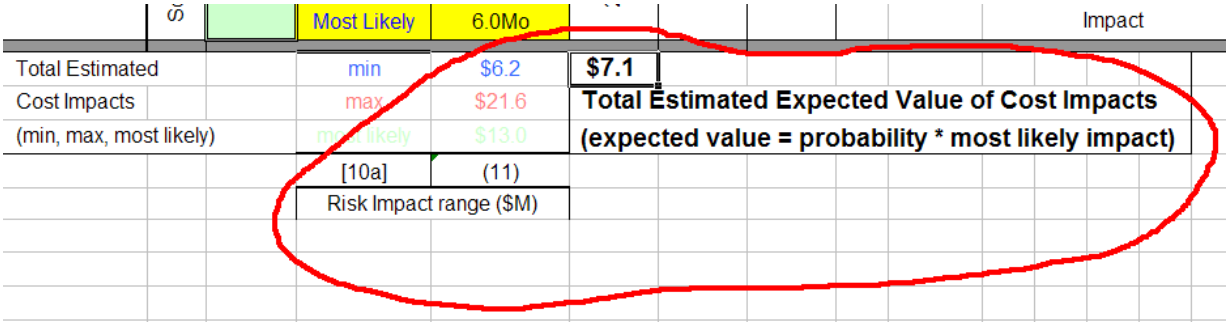
Notice the first 15 columns in the risk management plan spreadsheet are devoted to Identify and Analyze – the first pillar of risk management. The remaining columns (16 thru 25) are devoted to the second pillar of risk management – RESPONSE, MONITOR and CONTROL.

In Chapter 5 we reviewed in some detail risk response actions, in this chapter we follow-up and follow-through with monitoring and control. The way we "monitor and control" risk is regularly review the effectiveness of the response. Are the response actions working? Are things getting better? Are we more confident about our ability to meet project objectives after the response actions have been implemented?

In effect response, monitor and control is a natural component of our day-to-day project management activities, communicate with the project team and ascertain how things are going. Make note in the risk management plan and document the results.

Notice that Figure 6-1 only lists 5 risks – most will agree this is not too many to manage, but is it enough to make a difference for our project. The answer is a resounding YES and it is demonstrated in the example provided. Figure 6-4 below depicts the bottom of the RMP Spreadsheet under column 11, notice that for these 5 risks there is an expected value of $7.1 M.

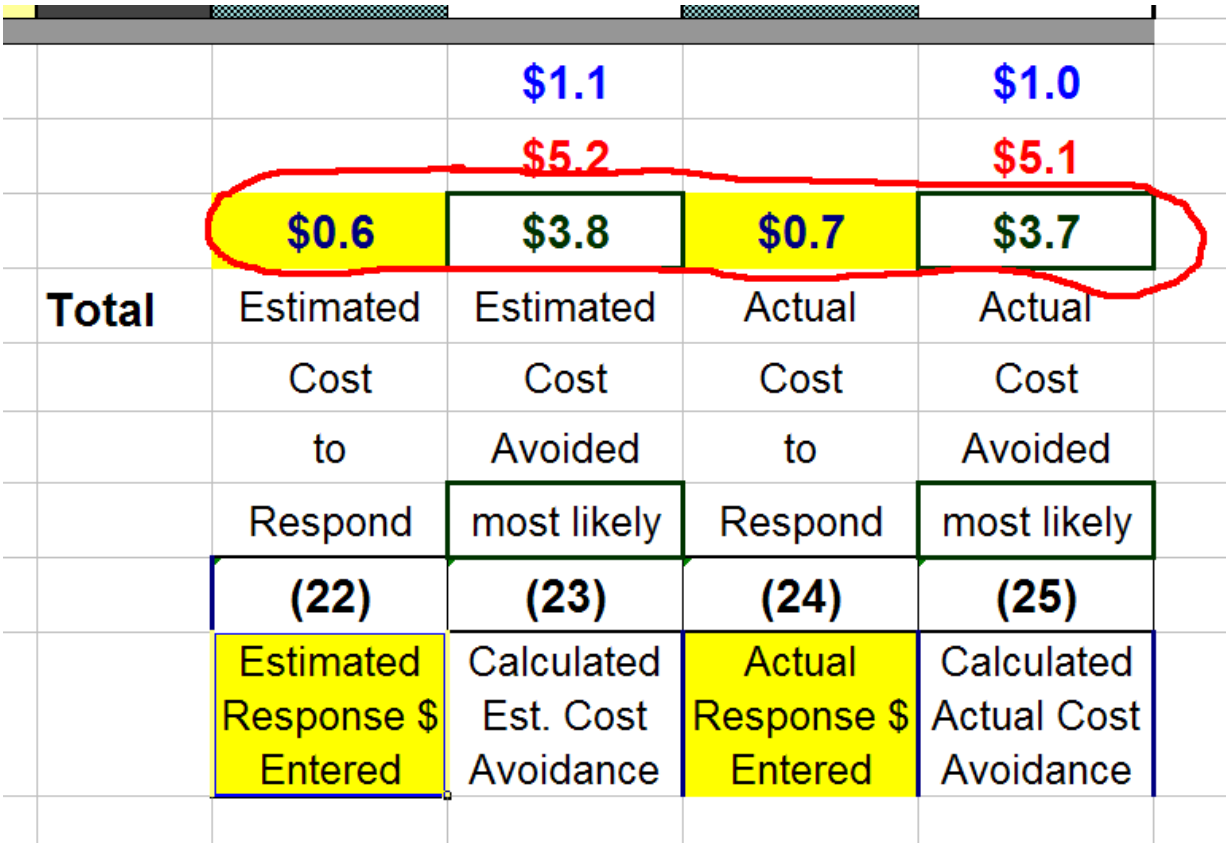
It should also be recognized that this project identified over 50 risks, 23 of which were deemed significant enough to warrant inclusion in the quantitative risk analysis model. These five emerged as the top ranked risks after the analysis and provided the project manager a prioritized list of risks to manager. The other 40+ risks were not simply ignored, they provided "issues awareness" for various specialty groups and were dealt with as each specialty group deemed appropriate for relevant risks; these additional risks also acted as a "watch list" for the project.



Total Estimated Cost Impacts of top 5 risks for the example project

Figure 6-4

The following page depicts a performance measure for the effectiveness of risk management on this project (Figure 6-5).



		$1.1		$1.0
		$5.2		$5.1
	$0.6	$3.8	$0.7	$3.7
Total	Estimated Cost to Respond	Estimated Cost Avoided most likely	Actual Cost to Respond	Actual Cost Avoided most likely
	(22)	**(23)**	**(24)**	**(25)**
	Estimated Response $ Entered	Calculated Est. Cost Avoidance	Actual Response $ Entered	Calculated Actual Cost Avoidance

Performance Measure of Risk Management for this project

Figure 6-5

When reporting on the risk management efforts for this project we can summarize as follows:

"The total dollar amount planned for response actions was $0.6M, to achieve reduced project risk exposure by an estimated $3.8M (expected value of risk reduction). After implementing the response actions we found the total cost of the response actions were $0.7M which avoided an estimated $3.7M in project costs."

This example illustrates an excellent return on the dollar for risk management efforts. Other benefits, less quantifiable, included: improved communication among team members and externally to stakeholders and the public; identified areas of concern for each specialty group as they helped develop the risk register during risk elicitation; greater confidence by the project manager and project team during project development; upper management was informed of the issues and there were fewer surprises; the information gleaned from the overall risk workshop and risk management effort resulted in more informed decision-making.

We can monitor and control a number of things in our risk management efforts, including:

Our state of readiness

Our commitment to looking ahead, and being prepared to improvise and adapt

The robustness of our risk response actions

The quality of our documentation

How earnestly we integrate risk management into our project management plan

Keeping our RMP up-to-date, including the RMPS spreadsheet

Our preparedness to provide the following performance data regarding our risk management efforts:

- Number of risks identified
- Number of significant risks, as determined through quantitative analysis
- Dollar value of significant risks
- Estimated cost of planned response actions
- Estimated value of costs avoided through risk management
- Actual cost of response actions
- Estimated Actual value of costs avoided through risk management
- Estimated amount of delay (months) avoided through risk management

Appendix A Project Risk Management Plan Template

A project risk management plan describes how a project team will incorporate the risk management process into its project management plan. ***Particular emphasis should be given to how a project team will respond to risks and monitor and control risk throughout the life of the project.*** *By identifying and analyzing risks, and then responding to risk aggressively and monitoring the effectiveness of the response, project teams can improve the odds of meeting project objectives.*

This template is a convenient tool for project teams wishing to develop a detailed risk management plan document; typically this is more common for highly complex project and/ or projects with significant risk.

The template presents an organized approach and is meant as a starting point only; project teams must tailor the document to meet the needs for the risk management plan for their project.

Project Risk Management Plan

Official Project Title: _____

SR ###, MP limits: _____

Project Manager: _____

Risk Manager: _____

WIN: _____

PIN: _____

L#: _____

Introduction

This document is the Risk Management Plan for this project; it is a plan of action that describes how this project team will deal with uncertainty and risk. Project risk management is an ongoing and integral part of project management and is performed throughout the life of the project. The Project Manager is responsible for reviewing and maintaining the Risk Management Plan to ensure that risk is appropriately dealt with by the project team.

Project Manager Review

Initial and date after each review and update of this risk management plan:

Year	Quarter 1	Quarter 2	Quarter 3	Quarter 4
2009				
2010				
2011				

Project Risk Management Plan[1]

A formal project risk management plan is: a detailed plan of action for the management of project risk. Project risk planning involves the thoughtful development, implementation, and monitoring of appropriate risk response strategies. It is the process to develop and document an organized, comprehensive, and interactive risk management strategy; determine the methods to be used to execute a risk management strategy; and plan for adequate resources. The project risk management plan may be specific in some areas and general in others. The key to this tool is its scalability. Every project should have a formal risk management plan, but the level of detail varies with the project complexity.

What is a project risk management plan?
It is a document that gives a summary of the project and outlines the steps of the risk management process and how the project manager and project team is approaching them. The risk management plan employed will vary based on the complexity of the project, but most project risk management plans should include an outline similar to the following:

1. Introduction
2. Summary
3. Definitions
4. Organization and roles
5. Risk management strategy/approach
6. Risk identification
7. Risk assessment and analysis
8. Risk response actions/allocation
9. Risk monitoring and control

Why use a project risk management plan?
It explains how a project manager and project team manages risk for their project. It provides guidance and requirements, and serves as a communication tool for those who wish to be informed of a project's risk management approach. The plan formalizes the ideas presented during the risk management process and may clarify some of the assumptions the project team has regarding the risk management process.

What does a project risk management plan do?
It provides specific guidance for the project team members in all steps of the risk management process for their project. The risk management plan documents the processes to use throughout the project for identifying, assessing, and managing risk.

When to develop and use a project risk management plan?
The formal plan should be developed during the Planning and Scoping Process and updated during subsequent project development phases.

How to use a project risk management plan?
The risk management plan is developed early in the project by collaboration with as many members of the team as possible. It should be consulted and revised throughout the project development process to guide the project through to completion.

1 *(from NCHRP 8-60 review draft –with edits)*

Duties

Project Manager	• Approve the project risk management plan. • Approve and insure implementation of response actions to identified risks, particularly significant risks that emerge as prospects for risk response. • Confirm who will carry-out response actions and when action will be taken, incorporate into work plan. • Monitor effectiveness of response actions. • Regularly review and update the project risk management plan. • Promote aggressive risk management for this project. • Actively participate in risk workshops. • Communicate to senior management the risk and uncertainty the project is exposed to and the action be taken to address it.
Project Team Member	• Pro-actively identify risks and their characteristics in terms of probability of occurrence and impact. • Pro-actively respond to risks within specialty area. • Document actions and report to project manager for inclusion in risk management updates. • Monitor effectiveness of response actions. • Communicate with project manager with regard to risk management actions and changing project risk profile (addition of new risks or retirement of old risks –as appropriate).
Project Risk Manager	• Prepare and update the project risk management plan. • Develop a schedule for key check-in milestones for review and update of the risk management plan. • Determine when risk workshops will be needed and that appropriate preparation is accomplished prior to the workshop. • Collaborate with the Strategic Analysis and Estimating Office, CREM unit to coordinate pre-workshop, workshop and post-workshop activities, including the need for consultants and/or other participants –both internal and external. • Oversee and manage day-to-day risk management process for the project. • Ensure quality of risk data. • Track and monitor effectiveness of response actions. • Promote risk management activities within the project team and with stakeholders. • Communicate with project manager on all matters related to risk management.
Risk Owner (Action Owner)	• Implement agreed response actions. • Report on effectiveness of the risk actions to the project manager/risk manager and affected project team members. • Identify new risks that may emerge after response actions. • Communicate with project manager regularly, including the need for other risk response actions if needed.

Project Risk Management Process

This project complies with all WSDOT directional documents and guidance for project risk management, including:

WSDOT Project Risk Management References	
Project Management Online Guide (pre-construction)	www.wsdot.wa.gov/Projects/ProjectMgmt/Process.htm
Project Risk Management Guidance for WSDOT Projects (Draft Working Document)	www.wsdot.wa.gov/Projects/ProjectMgmt/Process.htm
WSDOT Guidelines for CRA-CEVP Workshops	
Risk Management Plan Spreadsheet	
Reference materials on the topic of risk management and risk workshops at WSDOT.	

WSDOT Directional Documents relating to Project Risk Management	
IL 4071.00 Inflation and Market Conditions Applied to Base Estimates	July 13, 2007
E 1038.00 Enterprise Risk Management	September 4, 2007
E 1042.00 Project Management and Reporting System	July 1, 2008
E 1032.01 Project Management	July 1, 2008
Project Delivery Memo 07-01 Project Cost Estimate Creation, Update, Review and Approval Procedures	July 1, 2008
E 1053.00 Project Risk Management and Risk Based Estimating	December 10, 2008

1) Risk Management Planning

Risk Management will be a directed, focused and intentional effort for this project. To that end the following items are included in this risk management plan:

i. Level of Risk Assessment has been determined.

As indicated in E 1053.00 this project will conduct a Cost Risk Assessment workshop as required for all projects between $25M and $100M.

ii. Risk management activities are in the project schedule.

Risk management activities are included in the appropriate sections of the project schedule, using the appropriate WSDOT MDL codes.

MDL Code	MDL Name	Description
PE.PD.04	Cost Risk Estimate & Management	Cost Risk Assessment, is an integral element of project risk management at WSDOT, and quantifies, within a reasonable range, the cost and schedule to complete a project; we will identify, assess and evaluate risk that could impact cost and/or schedule during project delivery.
PE.PD.04.20	CRA Workshop	Cost Risk Assessment (CRA) is a workshop process similar but less intense CEVP®. The CRA workshop for this project is planned for January 2010 and is included in the project schedule; pre and post workshop activities are also included in the project schedule
NOTE: *Project teams need to add tasks and sub-tasks as appropriate to their project work activities using the appropriate MDL items.*		

iii. Risk management is an agenda item in regularly schedule project meetings.

Risk management is included as an agenda item on our monthly project meetings and is the number one agenda item each quarter.

iv. Communication to project team of our risk management effort and expectations has been communicated to the project team.

During Initiate and Align, Plan the Work and Endorse the Plan risk management has been communicated as an item of work for this project. Specifically it is included in the Team Mission/Assignment and in our Roles and Responsibilities.

v. Risk will be managed, documented and reported.

Incorporated into the project schedule and monthly meetings is an item for reporting on status of risk response actions. In addition this team will use the Risk Management Plan Spreadsheet for summarizing and tracking risk response action efforts for significant risks.

This Project Team is committed to aggressively and pro-actively managing risk. We recognize that project risk management is at the heart of project management and is an ongoing activity throughout the life of the project. We also recognize that two pillars of risk management and we embrace both, and we will respond to identified risks and track the effectiveness of our response actions.

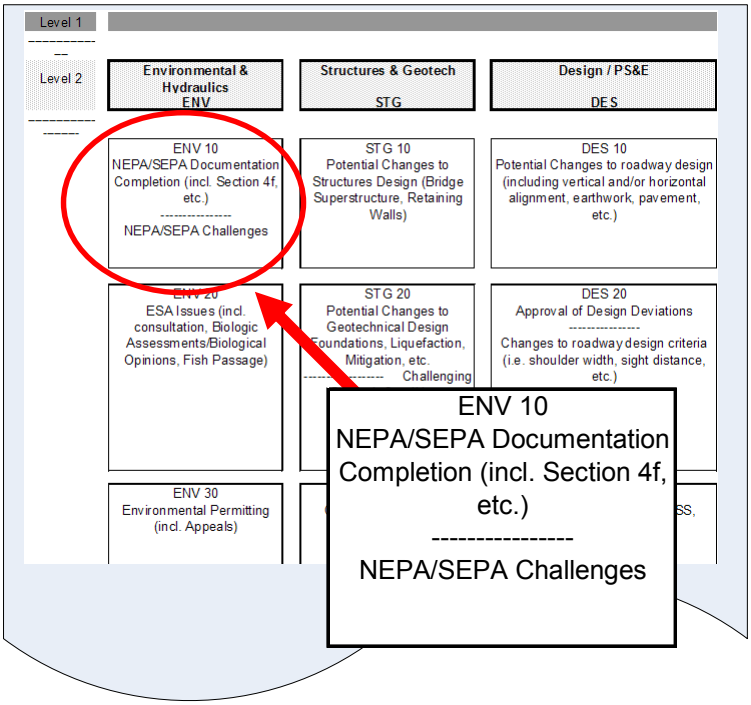
First Pillar of Risk Management (Identify and Analyze)

2) Identify Risk Events

This project team will begin identifying risks and building its risk register early in project development. Our risk manager will maintain the risk register in anticipation of the CRA workshop and following the risk management workshop. The WSDOT Risk Breakdown Structure (RBS), provided in Chapter 2 of the Risk Management Guide, is used for organizing risks via appropriate categories. Organizing risks in this manner provides a consistent and convenient way to monitor and track risks at the appropriate level of detail; this also allows for the development of a risk database by category.

An example of how to use the RBS is provided on the following page.

RISK BREAKDOWN STRUCTURE EXAMPLE ON HOW TO USE	ENV 10.01



ENV = Environmental/Hydraulics (Risk Category, Level 2 in the RBS)

ENV 10 = NEPA/SEPA Documentation (Level 3 in the RBS: 10 = Group within the category)

ENV10.01 = First Identified Risk in this Category and Group

3 Qualitative Risk Analysis

Initial analysis of risks will begin with a qualitative assessment; see Chapter 3 of the Risk Management Guide.

4) Quantitative Risk Analysis

Quantitative analysis of risks will begin with our CRA workshop in January 2010; see Chapter 4 of the Risk Management Guide for more detail on quantitative analysis.

Second Pillar of Risk Management (Respond, Monitor, and Control)

5) Risk Response Planning[2]

[3]Our Project Team is committed to making effective use of the actionable information that emerges from risk identification and analysis. Risk response strategy is the process of the project team determining what, if anything should be done with identified risks significant enough to impact project objectives. It leads to specific actions the project team will implement into their project management plan and work plans and then pro-actively execute; response actions for threats (avoid, transfer, mitigate-*reduce*) and opportunities (exploit, share, enhance) can be pursued or the risk event may be accepted if the response action is not cost-effective.

Response actions will be developed and implemented ***promptly*** following identification and analysis. Risks have a shelf life and risk management plans can become stale if not monitored and updated regularly, we are committed to making use of information when it is fresh and keeping our project management and risk management plans up-to-date so they do not lapse into irrelevance because they have become outdated and obsolete.

Chapter 5 of this document describes response actions for threats and opportunities. The project work plan, including the schedule and resource assignment establishes points at which response actions to identified risks will be implemented, including immediately following the CRA workshop for this project. In addition the members of this project team are reminded to be vigilant regarding risk for this project and to identify potential risk events as they think of them, with the purpose of responding appropriately to risk for this project.

Residual risks and responses (primary and secondary risks)
As a project develops its risk profile will change. Risks are identified, response actions are implemented which changes the nature of the project risk profile and new risks are identified. During risk identification we identify of risk events, the first time this is accomplished it constitutes a list of primary risks, as actions are taken, secondary risks can emerge as a result of implementing the treatment response to the primary risk.; where possible secondary risks should be dealt with as part of the primary risk response action. When developing our response actions we will be vigilant in considering the ramifications of the response actions. We will take measures to include strategies that deal with the primary risk as well as secondary risks and endeavor to minimize or eliminate residual risk as part or risk response efforts.

2 *Also referred to as Risk Treatment, Risk Mitigation, Risk Management or Risk Prevention in some publications.*

3 *Practical Risk Management by David Hillson and Peter Simon (with edits)*

6) Risk Monitoring & Control

Monitoring and control is not complete unless communication has occurred. ***COMMUNICATION*** is the lynch-pin of effective project management and risk management.

Communication within and among the project team will be crisp, concise, complete, correct and timely as will the communication to upper management and executives. Effectiveness of the risk response actions will be monitored and reported regularly, as indicated previously, at our project meetings; adjustments will be made as needed.

RISK MONITORING and CONTROL (*communication*)

- Project Team
  - Record assumptions that underlie judgments and decisions;
  - Monitor and document results of implemented risk response actions.
- Upper Management and Executives
  - Avoid unpleasant surprises;
  - Fully inform parties of risks, response actions and trade-offs;
- Accountability
  - Document the risk assessment process in such a way that it can be reviewed and examined for the reasons particular judgments and decisions were made.
- Control of risk and management activities
  - Specify criteria for risk management success, including targets and measures used to assess performance;
  - Follow-up with risk owners regarding the status of completing the risk response actions and the resulting effect, track resource allocation associated with risk response actions.

Project Risk Management Performance

Date of this Report: _____

Cost Risk Estimating Management

Project Risk Management Performance Summary Report
(Workshops held between MMMM DD, YYYY and MMMM DD, YYYY)

Performance Measures

	CRA Workshop #1	**CRA** Workshop #2	**CRA** Workshop #3	**CRA** Workshop #4
Workshop Date(s)				

	CRA Workshop #1	**CRA** Workshop #2	**CRA** Workshop #3	**CRA** Workshop #4
Pre-workshop Base Cost Estimate for Project				
Validated Base Cost Estimate for Project				

	CRA Workshop #1	**CRA** Workshop #2	**CRA** Workshop #3	**CRA** Workshop #4
Total # of Risks Identified				
Total $ Value of Threats				
Total $ Value of Opportunities				
$ Value of Prospects for Risk Response Actions				
$ Cost of Risk Response				
$ Cost Avoided through pro-active risk response				

RBS Code	**Risk Break Down Structure Group (Level 2)**	**Number of Risks**	**Value of Threats $**	**Value of Opportunities $**
ENV	Environmental and Hydraulics			
STG	Structures and Geotechnical			
DES	Design/PS&E			
ROW	Right of Way and Access			
UTL	Utilities			
RR	Railroad			
PSP	Partnerships and Stakeholders			
MGT	Management and Funding			
CTR	Contracting and Procurement			
CNS	Construction			