Risk Management Process

The process to incorporate risk management into an FDOT project consists of a series of steps, which are applied at the outset of the project and verified throughout the project. The major risk management process steps are illustrated below.

Uncertainties are the greatest at the project's beginning. As the project progresses, more and more information is known and the uncertainties are reduced. However, the only time that the actual cost of a project is truly know is after construction is complete and all the bills are paid. This could be years after the project began. The total project cost is divided into three categories:

- Costs that we can actually quantify at any point in time
- Costs that we know we are going to incur, but which we cannot yet quantify
- Costs that we do not yet recognize

Traditionally we have developed the Engineer's Estimate by being conservative in estimating those items that we can quantify either by inflating the quantity of those items, or by inflating the estimated cost or, usually, both. To that we add a contingency to account for the items that we cannot quantify and to cover the unrecognized costs (Risks). The contingency is usually a percentage of the known costs.

The Risk Management process attempts to develop a more realistic risk-based cost estimate by removing the intentional overestimates of the known items, providing an allowance for those items that cannot be quantified, and developing an estimate of the potential costs of risks based on a thorough understanding of the project's specific risks.

The following table provides a description for each step in the risk management process. Each step is then explained in greater detail in this chapter.

Step	Description
Define Project Base	• Define the "base" project scenario against which events (risks) can subsequently be identified, assessed, and eventually managed. The base cost and schedule should only include events that are planned for the project (no contingencies). Variability of impact in the planned events should be captured in the base as well. If there is any uncertainty that an event will occur, then it will need to be included in the risk assessment part of the process.
Identification	• Identify a comprehensive set of risks. This is accomplished by brainstorming scenarios that might change project performance. • Categorize each risk by the phase that risk might occur.
Assessment and Analysis	• Assess the impacts of each of the threats and opportunities in the risk register, and then prioritize them on that basis. • Generally accomplished by subjectively assessing the risks (i.e., the probability of the events occurring and the impacts if it does occur. • Analytically combine the base and risks to determine a range of outcomes (cost & schedule) for project (e.g., ultimate project escalated cost and schedule).
Risk Response Planning	• Identify and evaluate possible ways to proactively reduce risks and exploit opportunities, focusing on the most severe. • Evaluate each possible action in terms of its cost-effectiveness, considering changes in both base factors (e.g., additional cost) and risks (e.g., reduced probability), and select those that are cost-effective. • Consider subsequently re-analyzing the project performance for this risk mitigation program, based on which budgets and milestones can be established.
Monitoring and Control	• Implement the Risk Management Plan as the project proceeds by monitoring the status of risk mitigation activities and changes in risk and monitoring budget and milestones, especially with respect to contingencies. • This might involve periodic updates at regular intervals (such as monthly project progress meetings) or at major milestones or changes. • Contingencies might be reduced as engineering reports or designs are completed and risks are avoided or mitigated.

Initial Project Risk Management Meeting

At the outset of each project, a Project Risk Meeting will be held independently or in conjunction with the project kick-off meeting or Scoping Field Review. The first time that the Project Team Members meet, the PM should brief the team on the following:

- The importance and objectives of the project risk management process
- The roles and responsibilities
- The risk register
- The communication check points
- Key risk management activities in the project schedule
- Expectation that risk is managed, documented and reported via a formal process

The project team will identify what events might occur and thus change the project relative to the base conditions. The threats and opportunities are then listed in the risk register for later risk management activities. Developing this risk list is a creative process.

On Low Range projects, it is helpful if the project manager involves the key members of the project team in this task. FDOT PMs should also involve Project Managers from the preceding and following phases in identifying potential risks.

On more complicated Mid and High Range projects where use of a quantitative risk analysis process is required, the FDOT PM will involve the key members of the project team in this task. On these projects, the key members should include the PM, sponsor, customer, external stakeholders, and a representative from engineering, procurement, quality, HR, safety, finance, and operations. FDOT PMs should also involve PMs from the preceding and following phases in identifying potential risks.

Define Project Base

Preparing project information for risk management is a necessary and valuable first step in the risk management process. It provides the "base" for identifying threats and opportunities, assessing them, and eventually managing them. It also documents the current state or base line for future reference. Information needed to define the base includes:

- Brief Project Description
- Project Scope, Strategy/Status, and Key Conditions and Assumptions
- Initial cost estimate without contingencies
- Initial design and construction schedules without contingencies.

Formally, this process is called *Structuring*. Structuring can help facilitate subsequent risk identification and assessment (especially when a risk is already considered and addressed in the base conditions). For example, if a complex right of way issue is already accounted for by an appropriate design schedule, then what might be considered a schedule risk is already a part of the base project conditions and should **not** be considered as a risk. By understanding the structuring of the project, risks can more easily be identified for either qualitative or quantitative risk assessments.

Risk Identification

The first step in the Risk Management process is identification of potential risks to a project. Risk identification involves identifying potential project risks and documenting their characteristics, resulting in a list of potential project risks. As a starting point in the process, examples of potential project risks are listed in blue boxes adjacent to this section. This list should be supplemented based on the experience of the Project Manager and other team members, as well as historical data available from similar projects, studies performed by the District or the Central Office on similar projects and other appropriate sources. The actual list for each project should be unique, reflecting specific project conditions.

ORGANIZATIONAL RISKS

- Inexperienced staff assigned
- Lack of staff assigned to the project
- Loss of critical staff at critical point in project
- Insufficient time to plan project
- Unanticipated Project Manager workload
- Delays getting approvals and decisions
- Support units unavailable or overloaded
- Changed priorities
- Project under funded
- Inconsistent project goals (objectives, schedule, budget and quality)

Risk identification is an essential step in the risk management process. It determines what might happen that could affect the objectives of the project and how those things might happen. It produces a deliverable (the project risk register) that documents the risks and their characteristics. The risk register is subsequently strengthened through the qualitative or quantitative risk analysis, risk response, and risk monitoring processes. Risk identification is an iterative process because new risks may become known as the project progresses through its life cycle, previously identified risks may be retired, and other risks may be updated.

A challenge in risk identification is avoiding confusion between **causes** of

EXTERNAL RISKS

- Right of way delays as a result of court actions
- Changed priorities
- Local communities or groups pose objections
- Funding changes
- Political factors change
- Stakeholders request late changes
- New stakeholders emerge with new demands
- Influential interests raise objections
- Lawsuits to halt or change the project
- Pressure to choose time over costs or quality
- Delays in agreements with local agencies, railroads, etc.
- Utility relocation delays
- Permitting issues

ENVIRONMENTAL RISKS

- Delays in permit approval
- Changed requirements for permits
- Changes in environmental regulations
- Reviewing agencies require higher-level review than expected
- Lack of specialized staff to perform environmental analysis
- Unidentified special-interest sites discovered (historical, endangered species, etc.)
- Environmental class of action changes
- Public controversy arises over environmental issues
- Change in alignment requires new environmental analysis
- Section 4(f) lands become involved
- Pressure to compress the schedule for environmental analysis

risk, the actual risks, and the **effects** of risks. A risk may have one or more causes and, if it occurs, one or more effects.

- **Events** are circumstances in the project or its environment, which give rise to uncertainty. Examples include the need to use an unproven new technology or the lack of skilled personnel. Causes themselves are not uncertain since they are facts or requirements, so they are not the primary focus of the risk management process.
- **Risks** are uncertainties which, if they occur, would affect the project objectives either negatively (threats) or even positively (opportunities). Examples include the possibility that planned completion targets might not be met, escalation rates might fluctuate, or that requirements may be misunderstood.
- **Impacts** are unplanned variations from project objectives, which arise as a result of risks occurring. Examples include early milestone completion, exceeding the authorized budget, or failing to meet agreed quality targets. Effects are contingent events, unplanned potential future variations which will not occur unless the risks happen. As effects do not yet exist, and they may never exist, they cannot be managed directly through the risk management process. Including causes or effects in a list of identified risks obscures genuine risks, which may then not receive the appropriate degree of attention they deserve.

PROJECT MANAGEMENT RISKS

Many of the above issues will apply to the consultant as well, however consultant Project Managers must also address risk as it applies to profitability. Some unique risks for a consultant Project Manager may include:

- Incomplete or inaccurate scope of services
- Scope creep
- Unrealistic budget
- Unrealistic schedule
- Inappropriate, unnecessary or conflicting comments on FDOT reviews
- Late comments on submittals
- Unexpected rise in firm overhead
- Unresponsive subconsultant(s)
- Assessment of errors and omissions claims
- Change in FDOT Project Manager

PROJECT MANAGEMENT RISKS

- Project need and purpose poorly defined
- Project scope is poorly defined or incomplete
- Selection of a poor consultant or subconsultants
- Selection of a poor contractor
- Project Manager does not have control over staff priorities
- Too many projects
- Estimating and/or scheduling errors
- Poor communication within the team
- Unrealistic schedule
- Changed schedule
- Lack of coordination among support units
- Lack of management support
- Changes in key staff members

TECHNICAL RISKS

- Preceding phase project deliverables are incomplete
- Preceding phase reports/ plans are in error
- Right of way studies are not accurate
- Environmental analysis is incomplete or in error
- Unexpected geological issues
- Inaccurate design assumptions in PD&E Report
- Surveys are late or are in error
- Geotechnical reports in error
- Hazardous waste analysis incomplete or in error
- Need for design variations or exceptions
- Context sensitive solutions create design delays

One way to clearly separate risks from their causes and effects is to use a description with required elements to provide a **three-part structured "risk statement"**:

"As a result of (If) ___(event), then ___(risk) may occur, which would lead to ____(impact)."

Examples Include:

- "As a result of using a new technology (a definite requirement), unexpected design problems may occur (an uncertain risk), which would lead to overspending on the project (an impact on the budget objective)."
- "Because our District has never done an interchange project like this before (fact = event), we might misunderstand the requirements (uncertainty = risk), and our project would not meet the performance criteria (contingent possibility = impact on objective)."

The risk register should include those situations and conditions that have a reasonable likelihood of occurring and that will have some impact on the project.

It is not necessary to list those that are only technically possible or those that will have a very minor impact on the project. At the risk identification stage, the impacts on cost and time are not analyzed – this analysis occurs later through either a qualitative or quantitative assessment.

Assessment and Analysis

The next step in the risk management process is to qualify and prioritize the identified risks. This process involves considering probability and impact separately, then prioritizing the risks using a combination of both. Careful and objective definitions of the levels of probability and consequences, or impact, are critical to the creditability of the process. By assessing the "severity" of each risk, an action plan can be developed which assists in making better project decisions.

To assess the severity (impact rating multiplied by probability rating) of each risk in the risk register, and then prioritize them on that basis is generally done by:

- Subjectively assessing the relevant risk factors (i.e., impacts if the risk occurs and the probability of the risk occurring), either ***qualitatively*** (e.g., "high" vs. "low", where these descriptors are quantitatively defined by ranges of values); or ***quantitatively*** (in terms of mean-values or, for quantitative risk analysis, full probability distributions); and then
- Analytically combining the risk factors to determine changes in project performance measures and thereby severity

Qualitative Risk Analysis - The project manager or project team assesses each identified risk in turn and determines:

- The **rating for the probability of the risk occurring**, and
- The **rating of cost and time impact of each risk**, should it occur.

Qualitative risk analysis includes methods for prioritizing the identified risks for further action, such as risk response. This analysis assigns a Risk Rating to each risk in the risk register. The risk ratings help to determine where the greatest effort should be focused in responding to the risks. They facilitate structured risk response action and resource allocation. The three ratings Low Range projects are:

- "High" –Priority for risk response.
- "Medium" – Risk response as time and resources permit.
- "Low" – No risk response required at this time.

Why is the Qualitative Analysis used? - Qualitative analysis involves characterizing the likelihood and consequences in terms of non-quantitative ratings. A risk might be assessed to have a High (H) likelihood of occurrence and a corresponding Medium (M) cost impact and Low (L) schedule impact if it occurs along with a numerical rating (e.g., 1 through 5). On the benefit side, qualitative assessments may be relatively quick to conduct and provide a simple visual rating (depending on the method used).

To assist with this identification, the following table provides a standard definition of risk probability and impact ratings. The cost impact ratings may be easier to apply if expressed in terms of dollars. The ratings for the project serve as a consistent frame of reference for the project team in assessing the risks during the life of the project.

This table is intended as a guide. The project team may define dollar and time ranges as appropriate for the project. The impacts are to the overall project. Schedule delay applies to risks that are on the critical path (the longest path). During the Planning and Design phases, delays that impact the project let date may be of primary interest. During construction, delays impact project completion.

Rating ➔	1 Very Low	2 Low	3 Medium	4 High	5 Very High
Cost Impact of Threat	Insignificant cost increase	<5% cost increase	5 – 10% cost increase	10 – 20% cost increase	>20% cost increase
Cost Impact of Opportunity	Insignificant cost reduction	<1% cost decrease	1 – 3% cost decrease	3 – 5% cost decrease	>5% cost decrease
Schedule Impact of Threat	Insignificant delay	<1 month delay	1 – 3 months delay	3 – 6 months delay	>6 months delay
Schedule Impact of Opportunity	Insignificant improvement	<1 month improvement	1 – 2 months improvement	2 – 3 months improvement	>3 months improvement
Probability	1–9%	10–19%	20–39%	40–59%	60–99%

Drawbacks of qualitative assessments can include the following:

- Ratings can be vague, if qualitative ratings are not tied to specific values (e.g., what does a "High" likelihood of occurrence really mean?). As a result, different people can interpret qualitative ratings in different ways, which might lead to inaccuracies or problems in developing consensus. This underscores the importance of experience, good judgement, and team discussion.
- If the ratings (e.g., for likelihood and consequence) are not combined, then no overall measure of the risk is possible, which means that the register of risks cannot be ranked or prioritized.

How is the Qualitative Analysis performed? - Qualitative risk analysis for Mid-Range projects entails assigning a risk rating to each risk in the risk register. The risk ratings for probability and impact can then be combined for an overall risk ranking (based on risk severity). The risk rankings determine where the greatest effort should be focused in responding to the risks. Note the impact rating scale is exponential to increase the severity of "High" and "Very High" impacts. They facilitate structured risk response action and resource allocation. The overall ranking for each risk is then used to prioritize mitigating actions.

When and Why is the Qualitative Analysis updated? - Team members revisit qualitative risk analysis during the project's lifecycle, typically at a project's milestones. When the Team repeats or revisits qualitative analysis for individual risks, trends may emerge in the results. These trends can indicate the need for additional risk management action on particular risks or even show whether a risk mitigation plan is working.

Quantitative Risk Analysis - To perform this analysis, the Project Manager leads the Team in quantifying cost and schedule risks. This a way of numerically estimating the probability that a project will meet its cost and time objectives. The degree of uncertainty in each schedule activity and each line-item cost element is represented by a probability distribution.

- The probability of the risk occurring is expressed by two values: "Low" and "High" that cover the range.
- Three-point estimates are used for cost and schedule impacts. The three-point estimate consists of determining the "Low" (optimistic), "High" (pessimistic) and "Most Likely" values for the cost and time. The most likely value may be omitted if it cannot be established credibly, leaving a range of low to high.

Risk response strategies and actions are the same as described previously in this section. Response strategies for each risk should be carried through the project with documentation in project status meetings, and at project milestone meetings. For complex projects a formal risk report should be developed.

Once potential project risks have been prioritized through the Qualitative Risk Analysis process described above, the effect of those risks on the project can be quantified. The Quantitative Risk Analysis process analyzes the effect of the prioritized risk events and assigns a numerical rating to those risks. The quantification of risks involves assigning a cost in dollars of impact should the risk occur and a probability of the risk occurring. The results of a quantitative risk analysis can help differentiate risks that may have identical qualitative results (e.g., where a

qualitative analysis for a *low probability / high impact* risk results in medium severity…and a *high probability / low impact* risk also results in medium severity).

The purpose of risk quantification is to:

- Quantify possible outcomes for the project and their probabilities
- Assess the probability of achieving specific project objectives
- Identify risks requiring the most attention by quantifying their relative contribution to overall project risk
- Identify realistic and achievable cost, schedule, or scope targets, given the project risks
- Determine the best project management decisions when some conditions or outcomes are uncertain

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 impact of all identified and quantified risks.

This analysis starts with the projects schedule and its cost estimate. The degree of uncertainty in each schedule activity and each line-item cost element is represented by a probability distribution. The probability distribution is usually specified by determining the optimistic, the most likely, and the pessimistic values for the activity or cost element. This is typically called the “3-point estimate”. The three points are estimated by the project team or other subject matter experts who focus on the schedule or cost elements one at a time. By evaluating the resulting cost and time estimates for each of these three estimate points, it is possible to answer such questions as:

- How likely is the current plan to come in on schedule or on budget?
- How much contingency reserve of time and/or money is needed to provide a sufficient degree of confidence?

Why is the Quantitative Analysis used? – As the number of project risks increases (Mid and High Range Projects), the possibility of impacts to the project schedule and cost increases. A quantitative risk analysis is a further refinement to the risk management process which considers numerical values to develop a probabilistic scrutiny of the project. This analysis:

- Quantifies the possible outcomes for the project and assesses the probability of achieving specific project objectives,
- Provides a quantitative approach to making decisions when there is uncertainty, and
- Creates realistic and achievable cost, schedule or scope targets.

How is the Quantitative Analysis performed? - There are several techniques for quantifying risks including interviewing stakeholders to determine probabilities and impacts, sensitivity analysis, decision tree analysis, and simulation with probabilistic modeling (i.e. Monte Carlo technique).

The Project Manager leads the project team in quantifying ranges for cost and schedule risks. Ranges for probability of the risk occurring and the impact to cost and schedule are estimated by determining the “Low” (optimistic), “High” (pessimistic) and “Most Likely” values for the cost and time.

The cost impacts include direct costs only; they exclude any cost of delay. Schedule impacts are expressed in days of potential delay due to the risk. Some risks may not have both cost and schedule impacts.

An example of a quantitative risk analysis could involve an urban widening project that is highly controversial. The FDOT project manager expects there to be considerable public opposition. One public meeting is scheduled to occur during the Phase III design. The project team assesses there is a 60% chance that the opponents to the project could cause a significant redesign during Phase III and that the cost of the redesign would be $400,000 plus a significant delay in the

project schedule. The team determined that the risk could be mitigated through an aggressive public involvement program involving additional public meetings, meetings with elected officials, meetings with other public interest groups, and the preparation of high-end tools such as a fly-through. The cost of the additional public involvement activities is $100,000. The project team expects the aggressive public involvement effort will reduce the likelihood of the opponents causing a significant redesign and associated delay from 60% to 20%. The risk value is reduced by $160,000 ($400,000 x (60%-20%)). In this case, it would be appropriate for the Department to undertake the aggressive public involvement program. The costs associated with the Departments aggressive public involvement program can be included in the cost baseline as the project migrates through the planning process.

When and Why is, the Quantitative Analysis updated? - Team members revisit quantitative risk analysis during the project's lifecycle. When the Team repeats quantitative analysis for individual risks, trends may emerge in the results. These trends can indicate the need for additional risk management action on particular risks or even show whether a risk mitigation plan is working. Annual updates are generally done just prior to the Work Program update.

Risk Response Planning

Regardless of the tool used to identify risk, the real value of the process lies in developing mitigation strategies for the risks identified. By developing a plan to mitigate the risks and then tracking the team's progress, the likelihood of avoiding threats and taking advantage of opportunities increases greatly. Risk Management is an ongoing process. There should be a standing item on the regular team meeting agenda to review the current state of risk items.

Each risk management tool includes the ability to identify and track response strategies for each identified risk. This typically consists of choosing a response approach, assigning responsibility, and then tracking progress. Additionally, costs associated with the response should be estimated.

Each of the risks identified by the team should be assigned to an individual who will be responsible to implement the response strategy.

At each team meeting the Project Manager should go through the Risk Register and get a status from the responsible party. This is especially important at all Milestone meetings.

Risk planning and response is the process of developing strategic options, and determining actions, to enhance opportunities and reduce threats to the project's objectives. A project team member is assigned to take responsibility for each risk response. This process ensures that each risk requiring a response has a known owner monitoring the responses, although the owner may delegate implementation of a response to someone else.

Risk response planning should focus initially on the high priority. The intermediate priority risks can be addressed as time and resources permit. Low priority risks are usually considered acceptable risks and are not usually addressed in a risk response plan (or the response strategy is "accept" the risk).

Risk Response Strategies - A risk response plan should assign a response strategy to each risk considered. The best strategy is a function of the cost associated with the strategy and the degree of remaining risk after taking the action. This is essentially a qualitative benefit-cost analysis. Once a strategy is selected, the Project Manager and team need to update the scope, project cost, and schedule. The strategy needs to be monitored throughout the project to ensure the strategy is in fact effective in mitigating the risk.

Risk response consists of specific options that are available during a particular project development phase to recover project cost or schedule. Typically, each

such option is available only through that particular project phase, and then is no longer available, or its recovery value is substantially reduced, after a particular point. Thus, the risk response is a decision point/strategy to *avoid, transfer, mitigate, or accept* a project risk. Also note the equivalent strategies for opportunities (i.e., *exploit, share,* and *enhance*). The following table includes definitions for each of these risk response strategies. Some actions may use more than one of these strategies. The intent of using these strategies is to spur the development of possible risk management actions.

Implementation of these efforts will require resources (e.g., additional design hours, additional coordination efforts, use of more expensive materials). The results of the management actions will be mitigation of the probability of occurrence of a risk and/or a reduction in the impact. For an opportunity, increase in the probability and impact.

RISK RESPONSE STRATEGIES

For Threats	For Opportunities
Avoid • The Project Manager recommends changing Possible actions include changing the scope, adding time or adding funds. • Remove threat cause or change the project plan to eliminate the risk or protect the project from its impact. • Possible actions include changing the scope, project work plan and/or consultant contract, adding time or adding funds. • Not all threats can be avoided or eliminated, and for others, this approach may be too expensive or time-consuming.	***Exploit*** • Exploit is an aggressive response strategy, best reserved for those “golden opportunities” having high probability and impacts.
Transfer • Change the scope of a proposed or existing contract to transfer the risk to a consultant, contractor, or insurance company. • Find another party willing to take responsibility for its management and bear the liability of the threat. • Ensure that the threat is owned and managed by the Team member or stakeholder best able to manage it effectively. • Usually involves payment of a premium, and the cost-effectiveness of this must be considered.	***Share*** • Allocate ownership of an opportunity to another party who is best able to maximize its probability of occurrence and increase the potential benefits if it does occur. • Allow sharing in the potential benefits (e.g., Construction Value Engineering Proposals).
Mitigate • Reduce the probability and/or impact of an adverse event (threat) to acceptable threshold. • Take early action to reduce the probability and/or impact of a threat is often more effective than repairing damage after risk has occurred. • May require resources or time and is a tradeoff between doing nothing versus mitigation cost.	***Enhance*** • Modify the “size” of the positive risk. • Increase probability and/or impact, and maximizing benefits realized for the project. • If the probability can be increased to 100 percent, this is effectively an exploit response.
Acceptance • When it is not possible or practical to respond to the risk by the other strategies, or a response is not warranted by the importance of the risk, the best decision may be to accept certain risks. • When the Project Manager and the project team decide to accept a risk, they are agreeing to address the risk if and when it occurs. • A contingency plan or workaround plan may be developed for that eventuality.	

Risk Response Examples - The following table provides a few example risks along with various responses:

RISK RESPONSE EXAMPLES		
Phase	**Risk Statement**	**Risk Response**
Design	Inaccuracies or incomplete information in the survey file could lead to rework of the design.	**Mitigate**: Work with Surveys to verify that the survey file is accurate and complete. Perform additional surveys as needed.
	A design change that is outside of the parameters contemplated in the Environmental Document triggers a review which causes a delay due to the public comment period.	**Avoid**: Monitor design changes against ED to avoid reassessment of ED unless the opportunity outweighs the threat.
Environmental	Potential lawsuits may challenge the environmental report, delaying the start of construction or threatening loss of funding.	**Mitigate**: Address concerns of stakeholders and public during environmental process. Schedule additional public outreach.
	Nesting birds may delay construction during the nesting season.	**Mitigate**: Schedule contract work to avoid the nesting season or remove nesting habitat before starting work.
Right of Way	Due to the complex nature of the staging, additional right of way or construction easements may be required to complete the work as contemplated, resulting in additional cost to the project.	**Mitigate**: Re-sequence the work to enable right of way certification.
	Due to the large number of parcels and businesses, the condemnation process may have to be used to acquire right of way, which could delay start of construction by up to one year, increasing construction costs and extending the time completion.	**Mitigate**: Work with right of way and project management to prioritize work and secure additional right of way resources to reduce impact.
Construction	Hazardous materials encountered during construction will require an on-site storage area and potential additional costs to dispose.	**Accept**: Ensure storage space will be available and include disposal costs.
	Unanticipated buried man-made objects uncovered during construction require removal and disposal resulting in additional costs.	**Accept**: Include a supplemental work item to cover this risk.

Risk Assessment Bias - Bias must be recognized and addressed. The goal of risk-factor assessment is to obtain accurate, defensible assessments. As mentioned previously, subjective assessments are usually required to assess risks (likelihood of occurrence and impact) but are subject to bias. Bias essentially comes in two forms:

- "Motivational bias" occurs when someone says something that contradicts what they believe. This bias can be difficult to detect and counter but is often present when participants have a high stake in a project's continued survival or other conflict of interest. It can also occur when experts intentionally inject some conservatism into their assessments or intentionally exclude some scenarios.
- "Cognitive bias" occurs when someone believes something that is inconsistent with the facts. Most people will overestimate what they know about a particular topic, which leads to over-optimism and to underestimating uncertainty.

Risk bias can be addressed by ensuring and facilitating open discussions with Team members during the assessment and encouraging participants to share the basis and assumptions of their input. Project teams tend to be overly optimistic in the early phases of project development. Risk management helps to temper or tamp down this natural tendency.

Responding to Risks - Following identification and analysis of project risks, the project team acts in response to the risks to improve the odds in favor of project success. Ultimately, it is not possible to eliminate all threats or take advantage of all opportunities – but they will be documented to provide awareness that they exist and have been identified. Successful risk response will change/update the risk profile through the project life cycle, and risk exposure will often diminish. Risk response involves:

- ***Prioritizing*** and determining which risks warrant a response and identifying which strategy is best for each risk.
- ***Assigning*** an action to the Risk Owner to identify options for mitigating the probability or impacts of each threat or increasing the probability/impact of an opportunity. The Risk Owner takes the lead and can involve experts available to the project.
- ***Evaluating*** each option for potential mitigation of the risk and cost of implementing the option.
- ***Selecting*** the best option for the project.
- ***Adjusting*** project budget and schedule; justify changes for as necessary.
- ***Assigning*** an action to the Risk Owner to execute the selected response action. The Risk Owner is the lead and may assign specific tasks to other resources to have the response implemented and documented.

If the project team judges that a risk should be accepted, it may assign an action to the Risk Owner to prepare a contingency plan if deemed necessary. Accepted risks should be communicated as necessary to higher levels of management, particularly when there is a "need to know".

Risk Perspective Can Enhance Decisions

When considering risk mitigation methodology:

- Recognize the impacts of the decision;
- The impact of responding to a risk may make sense in the short term (e.g. Saves design costs, allows Team to meet schedule), but risk impact should be considered in context of the entire project.

For example, the impact of a few unknown conditions can affect construction where the window of an environmental activity requires the project to be suspended.

While the direct cost to resolve an unknown condition may be less than the cost of a site visit, *the overall impact of the change may be a significant delay to the contract if not recognized.*

Project Contingency - Even after proactive risk management, there will be residual risks, which FDOT must accept and thus accommodate in the budget and schedule. Typically, this is done by establishing and controlling contingencies for cost and for schedule, over and above the base cost and schedule. These contingencies can be established at various levels of conservatism or levels of confidence in their sufficiency; the higher the level of conservatism, the higher the chance that the contingencies will be sufficient. However, the more funds that must be committed to the project means those funds are not made available for other projects. This underscores the need for a balanced approach, judgement, and big picture thinking.

Monitoring and Control

The implementation and control of a Risk Management Plan consists of three main elements designed to optimize project performance:

1) plans for individual risk reduction actions

2) protocols for contingency management

3) protocols for recovery plans

Because project conditions, and hence risks, inherently change as a project moves through the development process, the Risk Management Plan is intended to be an evolving document, adjusting as the project develops. This in turn requires monitoring (e.g., of the progress and results of specific risk reduction action, of specific risks in the risk register, and of contingency) and periodic updating (e.g., of residual risks, of risk reduction plans, and of contingency requirements).

It is the Project Manager who has the overall responsibility for implementing the plan. The Project Manager will then typically delegate responsibility for various elements of the plan to those who are in the best position to monitor and complete them. The Project Manager will then follow-up to ensure that those delegated elements have been completed. This needs to be done as efficiently as possible to prevent wasting precious resources. For example, it is envisioned that risk management status will be incorporated into regular project status meetings. Similarly, risk management status should be incorporated into project status meeting minutes and distributed in a timely fashion. Delegation and tracking should be as efficient as possible.

Risk Reduction Actions – A set of actions are specified for reducing individual risks. These actions must be successfully carried out to realize any risk reduction, although the actual amount of risk reduction, and typically to a lesser extent their cost and schedule to implement, will be uncertain beforehand. However, such actions can be adjusted (e.g., stopped) as their projected performance or need changes.

Risk Monitoring and Updating - Continuous monitoring by the Project Manager and the project team ensures that new and changing risks are detected and managed and that risk response actions are implemented and effective. Risk monitoring continues for the life of the project. Because project conditions, and hence risks, inherently change as a project moves through the development process, the Risk Management Plan is intended to be an evolving document (and strategy), adjusting and adapting as the project develops.

When and Why is the risk register updated? - Risk identification, and therefore maintaining the risk register, is an iterative process because new risks may become known as the project progresses through its life cycle, previously identified risks are retired, and other risks may be updated. Risks change as the base project evolves, as conditions change, and new information becomes available. Eventually, each risk happens (and is mitigated) or does not happen (and can be "retired"). Generally, specific types of risk can only happen during specific project phases, after which they cannot occur. For example, a design risk will generally occur during the design phase, after which it can no longer occur. If the risk does not happen during design, its chance of occurrence drops to zero, and it can be "retired" after design. Thereafter, a review and discussion of the risk register at the beginning of each subsequent phase of the project is highly recommended.

Risk Monitoring and Updating

Risk monitoring and updating should occur at project status meetings and at the following project development milestones:

- Scoping Field Review
- Design Field Review
- Constructability Review
- Value Engineering
- 90% Plans
- Project status meetings