As a result of the passing of Measure M, Metro’s Capital Program has become unprecedented in size and complexity. Metro’s Program Management Plan (PMP), issued in October, 2016, outlines how Metro will manage and implement the capital improvement portion of the transportation infrastructure program. Success in managing such large, complex projects revolves around how well Metro identifies and manages project risks.

The PMP requires the Program Control Group, of the Program Management Department, to assists in managing scope, project status, budgets, schedules, estimates, document control, change control, risk management and reporting, and ensuring projects are delivered within cost, schedule, and risk expectations.

Historically Metro has implemented robust risk management processes on federally funded projects, in accordance with the Federal Transit Administrations (FTA) risk management requirements. The FTA requirements were developed in 2006 and were first implemented on the Metro Gold Line Project and then subsequently implemented on the Regional Connector, Crenshaw and Purple Line Extension Projects. However outside of these projects, application of risk management at Metro has been sporadic.

Metro recently formalized a comprehensive Risk Management Program Plan to monitor and assure adequate risk activities are consistently implemented on major capital projects. Procedure PC07: Risk Management Program Plan (Attachment A), which describes the framework for an internal Risk Management Program at Metro, has been expanded to provide a uniform risk identification and management process for application on all Metro transit, highway, regional rail, and other capital projects, regardless of size or type.
A major objective of the Risk Management Program Plan is to provide sufficient procedural guidance to allow internal execution of the risk management process by Metro capital staff, with administrative support and oversight from the Program Management Department. In this manner, project staff is positioned to take full ownership of the process and risks.

As each project executes the steps contained in the Risk Management Program Plan, the tools will be in place that are necessary to identify project uncertainties, assess the potential impact the uncertainties represent to project objectives, identify the actions required to manage the risks, assess the adequacy of the established contingencies to address the uncertainties, and assure routine cost and schedule trending and forecasting is done through a risk-informed perspective.

One such tool includes a web-based Risk Registry within the Metro Project Management and Information System Portal. The Risk Registry provides a central hub where individual project risk registers will be hosted and will provide a single source for all risk information at the program level. An extract from the risk register used on the Regional Connector Project is contained in Attachment B.

To successfully execute and implement the Risk Management Program Plan Metro have added a full time Risk Manager, to the Program Management Staff. The Metro Risk Manager will provide executive direction for the overall project function and oversee execution of initiatives directed from the Senior Leadership Team and the Board, and provide leadership and direction to the project control staff and consultants.

The Risk Management Program Plan will be instrumental in Metro’s efforts to reduce project risks and costs.
Attachments

Attachment A – Procedure PC07: Risk Management Program Plan
Attachment B – Extract from the Regional Connector Risk Register
1.0 BACKGROUND
The Risk Management Program Plan (the Plan) describes the framework for an internal Risk Management Program at Metro. The Plan provides a uniform risk identification and management process for application on all Metro transit, highway, regional rail, and other capital projects, regardless of size or type. To assure this uniformity, the Plan will be administered through the Metro Program Management Department, under the auspices of the Metro Risk Manager.

In the case of federal or state funded projects, the Plan will supplement, rather than duplicating or replace the FTA, FHWA and Caltrans risk management processes.
A major objective of the Plan is to provide sufficient procedural guidance to allow internal execution of the risk management process by Metro capital staff, with administrative support and oversight from the Program Management Department. In this manner, project staff is positioned to take full ownership of the process and risks.

As each project executes the steps contained in the Plan, the tools will be in place that are necessary to identify project uncertainties, assess the potential impact the uncertainties represent to project objectives, identify the actions required to manage the risks, assess the adequacy of the established contingencies to address the uncertainties, and assure routine cost and schedule trending and forecasting is done through a risk-informed perspective.

2.0 KEY RESPONSIBILITIES

2.1 Project Manager
The Project Manager is responsible for the overall success of the risk management process and for assuring the processes described in the plan are implemented.

2.2 Metro Risk Manager
The Metro Risk Manager will be responsible for overseeing and administering the Risk Management Program, acting as the Risk Assessment Workshop Facilitator, and preparing the Quarterly Risk Management Status Report. This responsibility includes assuring that Risk Workshop meetings are conducted according to the Readiness Review procedure checklist, identifying workshop participants, and determining skill sets/disciplines that will participate in the Risk Workshop.

3.0 DEFINITION

3.1 Risk
A Risk is an uncertain event or condition that, if it occurs, has a positive or a negative effect on at least one project objective. A risk may have one or more causes and, if it occurs, one or more impact.

3.2 Risk Management
Risk Management is the systematic process of planning for, identifying, analyzing, responding to, and monitoring project risks. It involves processes, tools, and techniques to maximize the probability and results of positive events and minimize the probability and consequences of adverse events that present risks to overall project objectives of cost, time, scope and quality.
4.0 PROCESS OVERVIEW

Project risk management is a scalable activity commensurate with the size and complexity of the projects. Smaller projects may use simple analysis, whereas larger more complex projects may use more robust analysis techniques.

The level of project risk management depends on total cost of the project, as well as other consideration, and the level of required risk management effort needed will be determined by the Project Manager and the Metro Risk Manager.

The Project Manager and the Metro Risk Manager will consider other factors to determine the risk level such as:

- Political sensitivity
- The type of project
- Location of the project
- Duration of the project
- Stakeholders of the project
- Metro’s sensitivity to the primary objective of the project (cost and schedule).

<table>
<thead>
<tr>
<th>Exhibit 1</th>
<th>Risk Management Requirements by Scalability Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scalability Level</td>
<td>Risk Management Requirements</td>
</tr>
<tr>
<td>1</td>
<td>Risk Register</td>
</tr>
<tr>
<td>2</td>
<td>Risk Register with qualitative analysis</td>
</tr>
<tr>
<td>3</td>
<td>Risk Register with quantitative analysis</td>
</tr>
</tbody>
</table>

Scalability levels differ in the Qualitative and Quantitative processes. All levels perform the other processes. Level 3 quantifies risks in probabilistic forecast terms of cost and time, whereas Levels 1 and 2 do not.

Irrespective of the project’s total cost, Level 3 must be used if any of the following activities are contemplated for the project:

- Validating the project’s contingency allowance
- Justifying and requesting additional contingency
- During construction, checking the adequacy of the remaining contingency
- During construction, requesting supplemental funds
- Allocating risks for alternative delivery projects
- Establishing the budget and/or completion date to a desired level of confidence.

4.1 Key Success Factors for Project Risk Management

Project risk management depends on incorporation of the principles of risk management into key project deliberations and decisions. Ultimately Project Risk Management is the responsibility of the project. Success in this process will depend on the incorporation of these principles into the project processes by the Project Manager.
4.2 Project Risk Management Process Steps

The project risk management process is guided by the steps of:

- Risk Management Planning
- Risk Identification
- Risk Analysis
- Risk Response Planning and Allocation
- Risk Monitoring and Control

The process is outlined and described below.

Exhibit 2  Risk Management Process
5.0 PROCESS STEPS

5.1 Risk Management Planning
Risk Management Planning is the process of deciding how to approach and conduct project risk management activities. Risk Management Planning ensures that the level, type, and visibility of risk management are commensurate with both the nature and extent of project risks and the importance of the project to Metro. Through planning, resource requirements for risk management are identified and the basis for evaluating and managing risks is defined. The Risk Management Planning process is completed early during project planning to ensure that risk management resources are available and that risk management standards can be effectively implemented.

As a sub-plan to the Project Management Plan (PMP), FTA requires federally funded projects to develop a Risk and Contingency Management Plan (RCMP) that follows the general guidelines of the FTA's Oversight Procedures. The purpose of the RCMP is to highlight specific areas of management focus, as identified through the risk evaluation process, which will be implemented. Successful implementation of the RCMP is important to the goals of Metro and the FTA, and monitoring of the RCMP implementation will be undertaken by both Metro and the FTA (through their PMOC). It is important, therefore, that the FTA, PMOC and Metro work collaboratively and develop an agreement on the substance of the RCMP.

For all other Metro projects, the risk management process will be fully described in the projects PMP.

5.2 Risk Identification
Risk identification will be performed at all project levels, Levels 1, 2 & 3.

Risk Identification is the process of determining issues that may affect the ability to achieve project objectives and documenting their characteristics.

The primary output of Risk Identification is a project risk register, which documents each of the identified risks.

The initial project risk register will be developed during the first Readiness Review checkpoint Risk Assessment Workshop and will be used as a primary tool for on-going risk management.

5.2.1 Risk Assessment Workshop Meeting
Risk Assessment Workshop meetings will be conducted within six to eight weeks prior to the Readiness Review checkpoint. Additional Risk Assessment Workshop meetings will be conducted as deemed prudent by the Project Manager and the Metro Risk Manager.

The workshops will be facilitated by the Metro Risk Manager or designee and attended by appropriate Metro staff members as Subject Matter Experts (SMEs) identified by “classification”. Note that all workshop meetings must include SME representation for the “core” Classifications, with optional SME representation depending on the type of project.
The Classification SMEs will include Metro staff currently assigned to other similar projects that are more advanced in the project lifecycle. This cross-project representation will provide the opportunity for Lessons Learned and information sharing, as well as subject matter representation that might not yet be fully in place on the project being assessed.

It may be appropriate to include certain outside stakeholders such as city, county, utility company representatives, FTA, FHWA and Caltrans, at the discretion of the Project Manager. It is appropriate to include CMSS and ESMC persons acting in a staff augmentation role at Metro.

5.2.2 Agenda Preparation
It is important for the Risk Workshop meeting to be highly structured to optimize the use of participants' time and to complete the risk identification and ranking process within one to three days, depending on the size and complexity of the project.

A detailed agenda should be prepared by the Project Manager and the Metro Risk Manager and issued to workshop participants prior to the workshop. In this way workshop attendees can be coordinated to attend specific, relevant portions of the workshop.

5.2.3 Meeting Facilitation Techniques
The meeting will be facilitated by the Metro Risk Manager or designee. The facilitator is responsible for not only guiding the meeting efficiently through the agenda, but for energizing and challenging the attendees into participation.
To facilitate discussion during the workshop a Risk Questionnaire will be issued to all workshop participants on which they will identify their top three to five projects risks, relevant to their area of expertise. The returned questionnaires will then be used in drafting an initial list of risks for discussion in the workshop. The risk questionnaire aids workshop participants in identifying risks that otherwise might not be raised in the open forum.

5.2.4 Risk Register

Identified risks will be recorded in the Project Risk Register

In the risk register, each risk is given a unique identifying number and is classified based on the following elements:

- Primary Work Package Affected (where contracting strategies have been defined)
- Work Breakdown Structure (WBS) Element (where applicable)
- Standard Cost Categories (SCC) Code (for federally funded projects)
- Risk Type (environmental, structural, geotechnical, design, right-of-way, utilities, stakeholder, management, contracting, construction)
- FTA Risk Category (for federally funded projects) - (requirements, design, market, construction)

The risk register serves as the primary document for collecting and distributing information on project risks.

The risk register, at a minimum, will include the following records:

- A unique risk identifier
- Current status (open or closed)
- A description of the risk event or uncertainty
- A description of the outcome or impact of the risk
- An exact or approximate likelihood rating (percentage or qualitative ranking)
- Cost and schedule impact ratings (exact amount, qualitative ranking, or description)
- Risk response actions and mitigation measures
- Risk owner (initially assigned to an organization, later to a specific individual)
- Notes for tracking comments on the risks and changes to the risks

The risk register will be hosted on Metro's Project Management Interface System (PMIS)

The risk register will be updated on a monthly basis with changes to likelihoods, impacts, mitigation measures, and comments. New risks will be added and risks that have passed will be closed. Risks are never deleted. This is to ensure that records of risks are not lost and can be revisited if necessary.
6.0 RISK ANALYSIS

6.1 Process Flow Chart
The Process Flow Chart shows the general steps to be taken in performing a qualitative and quantitative risk analysis along with ongoing management and monitoring of project risks and contingencies.

6.2 Qualitative Risk Analysis
Quantitative risk analysis will be performed at all project levels, Levels 1, 2 & 3.
A qualitative risk analysis is primarily used to prioritize risks by assessing their impact level relative to each other. This analysis is conducted by using a Risk Impact Matrix in which risks are ranked and prioritized based on the highest score.
Risks are assessed based on the probability of occurrence, potential (and most likely) cost impact, and potential (and most likely) schedule critical path impact. Total score is derived by adding the cost and schedule impact scores, multiplied by the probability score, or:

\[
\text{Score} = (\text{Cost} + \text{Schedule}) \times \text{Probability}
\]

An example of the scoring calculation based on the above metric is shown below:

- 40% Probability = 2
- $248,000 Cost Impact = 1
- 14-week Schedule Impact = 3

Resulting Score = 1 + 3 = 4 \times 2 = 8 \text{ (a Medium Risk)}

The probability score, cost and schedule impact score and rating score will be recorded in the risk register.

The purpose of risk quantification is to focus project management attention on the highest ranked risks and to aid as a tool to develop future strategies to manage risks.

6.3 Quantitative Risk Analysis
Quantitative risk analysis will be performed on Level 3 projects and other projects, at the discretion of the Metro Risk Manager.

Two methodologies for quantitative risk analysis will be adopted; for FTA, FHWA, Caltrans, and all other Metro projects, the bottom-up Monte Carlo approach and for FTA projects, the top-down approach.

6.4 Base Cost and Schedule Assessment
Risks are assessed on the basis of schedule and budget impacts. This assessment relies upon base costs and schedule durations exclusive of allocated, unallocated, and design contingency, as well as schedule contingency. In qualitative risk assessments, ranges are assigned to project cost elements to account for uncertainty associated with the cost of each budget element. Similar ranges are assigned to address uncertainty for schedule elements. These assessments are made with as much specificity as possible.

6.5 Bottom-up Cost Risk Analysis
Reliable scope, cost, and schedule data is critical to a successful risk outcome. Application of Metro’s Readiness Review Procedure and/or the FTA Oversight Procedures, verifies the reliability of the cost and schedule for scope consistency,
completeness, appropriate level of development for the current phase, reasonableness,
and mechanical correctness at periodic checkpoints in the project lifecycle.

Cost uncertainty is assigned to cost estimate items where it is believed that cost
uncertainty exists; this includes all allowances. For this analysis, allocated and
unallocated contingency is removed from the base costs. The base costs are then
stripped of any additional embedded, latent, or patent, buried, contingency contained in
individual line items.

The uncertainty can be described as either specific dollar amounts or as a percentage
range based on the estimator's confidence in the accuracy of the line item's cost. The
range values are informed using the estimator's judgment and, where possible, an
expert's opinion of the costs.

A likelihood (probability) of occurrence and probability distributions are assigned to the
identified risks.

In most cases, it is appropriate to use a triangular distribution which utilizes the
optimistic, most likely and pessimistic assessments of cost impact, although other more
appropriate distributions could be assigned, such as uniform, normal and PERT
distributions.

Early in project development, a risk may be assessed as having a relative impact (low,
medium, or high), which is then translated later into a monetary range ($0 to $500,000,
$500,000 to $1 million, or $1 million to $3 million). When nearing later stages of the
project, such as final design, risks will be given quantitative assessments such as
"between $1.3 and $1.7 million, with a most likely impact of $1.5 million."

In addition to the risk events derived from the risk assessment, the following elements at
a minimum must be considered in the risk assessment:

- **Escalation** is to be carried as a flat percentage per year (compounded monthly)
  where no additional information is available. Where additional information is
  available, such as economic forecasts, this information is integrated into the
  model and cited appropriately.

- **Material price changes** must be considered and, where possible, identified as a
  risk at the point in time when construction contracts are executed.

- **Bid market conditions** are to be assessed and forecasted as a risk at the point
  in time when a contract is executed.

- **Cost of delay** is considered where appropriate for delays to the contractor due to
  a risk owned by Metro. Risk for extended overheads for Metro, engineering, and
  construction must also be considered.

- **Design elaboration and the potential for scope increases** must be considered
  where designs are incomplete and there is a risk of additional scope or where the
  costs of design are expected to grow beyond current estimates.
6.6 Cost Risk Analysis Results
The cost risk analysis will result in a number of outputs useful in guiding risk response planning. Each of these outputs must be reviewed, evaluated, and analyzed to ensure the adequacy of the risk analysis and identify the root cause of any unexpected results.

6.6.1 Levels of Confidence Diagrams – Cost Risk Analysis
Monte Carlo simulations are used to develop level of confidence diagrams. These diagrams provide a measure of the confidence level for a given cost element and/or the costs required to achieve a given level of confidence. An example of a probability density function is shown below.

Exhibit 5  Bottom-up Cost Risk Analysis: Probability Density

6.7 FTA Top-down Cost Risk Analysis
The FTA Top-down Cost Risk Analysis involves completion of the FTA “OP 40 Risk Management FTA Model Risk Assessment Workbook”.

Based upon historical information, FTA has developed a model that takes the most optimistic cost estimate (lower bound) and the most pessimistic estimate (upper bound) to which a Beta distribution curve is applied. This results in a cumulative density function (or “S” curve) of likely project cost ranges versus probability. The intention is to produce a more accurate and realistic end cost forecast based on past trends. The multiplication factors between the lower bound and the upper bound are known as the Beta Range Factors (BRFs). The modeling process has been called a “top-down” analysis in contrast with the traditional risk register-based Monte Carlo analysis that is referred to as the “bottom-up” approach.
The Top-Down Beta Range Factor Analysis is based on OP-40 and applies BRFs to a "stripped cost estimate." The base cost estimate has been stripped of allocated and unallocated contingency and further reduced for embedded, latent, or patent buried contingency. BRFs are applied to the stripped cost estimate in accordance with FTA guidance. FTA developed a profile representing progressive risk reduction across the delivery cycle based loosely around historic trends and adjusted for real-life experiences.

The FTA top-down model distribution curves calculate a wide range of project cost outcomes based on past experience from numerous transit projects, and capture extreme variations, including unknown/unknowns. However the FTA focus is on the results at the 50 percent and 65 percent (P50 and P65) confidence levels to calculate the expected project value and the secondary mitigation target, respectively, because these values will not vary significantly at the remaining project stages.

### Exhibit 6  OP-40 Top-down Cost Risk Model Output

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<thead>
<tr>
<th>YOE Grantee values</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grantee total estimate (SCC 10-90)</td>
<td>2,934,813</td>
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<tr>
<td>Grantee exposed contingency</td>
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<td>Grantee stripped estimate (SCC 10-80)</td>
<td>2,635,466</td>
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<table>
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<tr>
<th>YOE PMOC values</th>
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<tbody>
<tr>
<td>Latent contingency</td>
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<td>Inflation Adjustment</td>
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<tr>
<td>Adjustments</td>
<td>0</td>
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<tr>
<td>Adjusted estimate</td>
<td>2,531,498</td>
</tr>
</tbody>
</table>

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<th>Model recommendations</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommended estimate</td>
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<tr>
<td>Contingency recommendation amount</td>
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<tr>
<td>Contingency %</td>
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<tr>
<td>Secondary mitigation target</td>
<td>3,121,629</td>
</tr>
<tr>
<td>Secondary mitigation recommended amount</td>
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</tr>
<tr>
<td>Secondary mitigation %</td>
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</table>

<table>
<thead>
<tr>
<th>Risk analysis</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower bound</td>
<td>2,531,498</td>
</tr>
<tr>
<td>Lower range reporting amount</td>
<td>2,889,373</td>
</tr>
<tr>
<td>Contingency target (Conditioned estimate)</td>
<td>2,974,483</td>
</tr>
<tr>
<td>Upper range reporting amount</td>
<td>3,317,744</td>
</tr>
<tr>
<td>Upper bound</td>
<td>4,759,183</td>
</tr>
</tbody>
</table>

### 6.8 Bottom-up Schedule Risk Analysis

For the schedule analysis, it is necessary to determine whether to utilize the available project schedule or to create a "summary schedule" as the basis for the risk model.
This decision is based upon the complexity of each schedule format. A summary risk schedule is typically developed when a project schedule contains multiple activities and relationships that preclude determination of the impact of schedule risk events.

The summary schedule is a critical path network with all activity ends closed, which is essential if a Monte Carlo simulation is to be conducted. While trying to incorporate all sections of the project for completeness, the summary schedule only includes those activities believed to be key and critical to the Project's completion and relevant to the risk assessment. Many lower-level activities are "rolled up" into more global activities shown to the extent that they are relevant to the risk analysis.

When a project schedule is used the schedule should be free of constraints that may affect the impact of risk on the schedule.

When performing a schedule analysis, it is also important to identify activities that may contain added schedule contingency. These activities will have uncertainty added to their durations; therefore, any contingency must be removed.

Using expert judgement the schedule activities are assessed for their optimistic, most likely and pessimistic durations.

Risks with schedule impacts are identified as having impacts on specific activities within the schedule. The activities that are affected are identified by their Activity ID and impacts are assigned directly to activities with specific distributions for each impact.

6.9 Schedule Risk Analysis Results

The schedule risk analysis will result in a number of outputs useful in guiding risk response planning. Each of these outputs must be reviewed, evaluated, and analyzed to ensure the adequacy of the risk analysis and identify the root cause of any unexpected results.

6.9.1 Levels of Confidence Diagrams – Schedule Risk Analysis

Monte Carlo simulations are used to develop level of confidence diagrams. These diagrams provide a measure of the confidence level for a given schedule element and/or the duration required to achieve a given level of confidence. An example of a probability density function is shown below.

Schedule risk assessment histogram must indicate a confidence level of at least 65% of achieving the project completion date.
6.10 FTA Top-down Schedule Risk Analysis

The FTA PMOC utilizes a top-down schedule risk analysis methodology to evaluate if sufficient schedule contingency is available, at any major review milestone, to absorb a project schedule delay equivalent to 25% of the remaining duration through the Revenue Service Date proposed for the project, calculated by adding the schedule contingency to the Adjusted Schedule.

Per example below, the duration from the current date, set at the workshop, to the stripped and adjusted project end date is calculated as 2,104 calendar days. 25% of this duration is calculated as 526 calendar days which is then added to the stripped and adjusted project end date to calculate the FTA target date.
RISK RESPONSE PLANNING AND ALLOCATION

After risks have been assessed, decisions regarding prioritization are made. The treatment of risks is classified as either primary or secondary risk mitigation. Related to both primary and secondary risk mitigation are the concepts of contractual risk allocation and the allocation and use of contingency.

7.1 Primary Mitigation

Primary mitigation occurs continuously throughout a project and is the result of the planned actions as described in the RCMP or PMP. Such activities are scheduled at the earliest phase during which the mitigation activity may occur, and are expected to be completed on a timely basis to achieve the cost and schedule risk parameter targets. Examples of mitigation might be completing a design, or a geotechnical survey, etc.

The objective of the risk response framework is to establish a planned approach to manage risks. The framework centers around four types of responses: (1) Avoidance, (2) Transfer, (3) Reduction/Mitigation, and (4) Acceptance:

- Risk Avoidance: A project element that is associated with a certain risk event can be eliminated; or the risk can be eliminated altogether.
- Risk Transfer: Responsibility for risk and its consequences is shifted from Metro wholly or partially (risk sharing) to another party. Risk transfers come at a price, which needs to be incorporated into the cost planning as an increase to a work package anticipated award amount.
- Risk Reduction: Actions can be taken that will either reduce the consequence or the likelihood of the risk event.
- Risk Acceptance: Recognition that further reduction of an identified risk would only come at the expense of the project's fundamental goals, such as unacceptable service loss or cost increase. Risk Acceptance usually involves the consumption of
cost or schedule contingencies, schedule float, or an increase in the overall project cost or schedule duration.

7.2 Secondary Mitigation
Secondary mitigation consists of pre-planned potential scope or process changes that may be triggered when risk events occur. Examples of events that may trigger secondary mitigation include construction bids that are significantly over the estimate, or encountering unexpected geotechnical hazards during construction. Such "triggered" mitigation enables the project team to make cost reductions or schedule modifications through a planned and orderly process potentially preserving contingency for use later in the project. Secondary mitigation is fundamentally different than value engineering, which is a formal, systematic, multi-disciplined process designed to optimize the value of dollars spent.

7.3 Contractual Risk Allocation
A number of strategies for proposed or actual allocation of risk between Metro and third parties are available including, but not limited to, the following:

- Risks can explicitly be assigned through contract scoping language, including instances of work assignments where risk consequences are apportioned among several parties; partial apportionment of risk liabilities will be exposed.
- Risks can implicitly be assigned through industry customs, legal precedent, or statutory authority.
- Contractual risk mitigation pools can be established. These include contingency of any type, management reserves, undistributed budget, incentive fees, variable profits, etc. These pools may be subject to shared savings provisions.
- Contractually expressed limitations to liability of known risks can be developed, as available to any party.
- Significant known risks for which no contractual assignment is apparent can be accepted by Metro or its contractors.
- Significant insurance provisions can be established that affect the assignment of liability of risk.

7.4 Contingency
Contingencies are set-aside estimated amounts (monetary set-asides for cost and time set-asides for schedule) that are included within the overall cost or schedule targets of a project. The amounts are designed to be used to overcome increases in cost or schedule attributable to potential risks, and for which no other mitigation measure is available. These contingency amounts may be associated with a particular activity or category of cost, as allocated contingency, or may be set aside in a general fund, as unallocated contingency. In most cases, the amount of risk a project experiences reduces as the project progresses toward completion; similarly, it is expected that the amount of contingencies required for a project also decreases over time; however, at no time will the contingency be totally consumed until all project risk is removed—usually only following project completion.
7.4.1 Cost Contingency
Project cost contingency is set at either the adoption of the life-of-project-budget (LOPB) or, for FTA projects, at Entry into Engineering and the project is required to manage contingency within the set amount.

As an aide to managing project contingency, the Metro Risk Manager will develop a cost contingency draw-down curve which will reflect minimum levels of contingency that must remain in the project budget at any given point in time and is used to protect from inappropriately early draw down of contingency funds.

New cost contingency may be created from a variety of sources including contract awards below estimates, value engineering savings, reductions in the risk level due to primary mitigations, and/or implemented secondary mitigations. Contingency that had been allocated in these cases will be transferred back into unallocated contingency.

The Cost Contingency Curve, shown below, will be the primary tool for cost contingency reporting.

Exhibit 9 Cost Contingency Draw-Down Curve (Sample)

The curve visually depicts if the project is consuming contingency more or less rapidly than planned. There are three curves on the chart, (1) Plan, (2) Actual/Forecast, and (3) a 10% buffer zone above the Actual curve. When contingency is either consumed or added to, as controlled through the cost forecasting process, the Project Control Manager updates the Actual curve for comparison to the Plan. Penetration of the Actual curve into the 10% buffer zone triggers additional risk management analysis. These actions will be through either Primary or Secondary mitigations, as discussed previously.
Further for a major construction project (over $100 million), a 3% percent Project Reserve will be established within the total project contingency. At such time as the Project Reserve is required to cover project costs, the LACMTA Board shall be notified and a forecast to complete the project shall be prepared.

7.4.2 Schedule Contingency

Project schedule contingency is set at either the adoption of the LOPB or, for FTA projects, at Entry into Engineering and the project is required to manage contingency within the set amount.

As an aide to managing project contingency, the Metro Risk Manager will develop a schedule contingency draw-down curve that will forecast the minimum amount of schedule contingency at the current, and future project milestones where significant changes in risk may occur.

The schedule contingency drawdown curve defines minimum levels of contingency that must remain in the project schedule at any given time. The drawdown-curve is used to protect against inappropriately early draw down of schedule contingency durations. Premature use of schedule contingency reduces the ability of the project to withstand schedule changes.

Schedule contingency is reported via the Schedule Contingency Draw-Down Curve, shown below.

Exhibit 10 Schedule Contingency Draw-Down Curve (Sample)

Schedule contingency can be consumed through realized schedule delays or can be created through shortened critical path activities, improved productivity resulting in shorter activity durations, effective risk management resulting in less
risk, VE benefits, implemented secondary mitigations, etc. These durations will be reflected in revised total contingency and reflected in the Schedule Contingency Draw-Down Curve.

When contingency is either consumed or added to, as controlled through the schedule forecasting process, the Project Control Manager updates the Actual curve for comparison to the Plan. Penetration of the Actual curve into the 10% buffer zone triggers additional risk management analysis and the implementation of schedule modifications.

7.5 Designating a Risk Owner, Action Items and Due Dates
Management strategies include specific plans or products, project control methods, responsibilities and authority designation, and measures of performance to track, manage, and reduce project risk.

The risk register includes the identification of the project team member responsible for and capable of managing the risk, and the measures necessary to reduce risk impacts on project objectives. The risk register also includes the timeline for implementing risk mitigation measures.

8.0 RISK MONITORING AND CONTROL

Risk review assessments will be ongoing, and risk register updates will be planned throughout the life of a project and, at a minimum, occur on a quarterly basis. Formal workshops will be performed in accordance with the requirements of the RCMP or PMP.

8.1 Quarterly Risk Meetings
To continue the goal of active risk management, quarterly risk meeting workshops will be held to update the risk response strategies. Previously developed risk responses will be updated and the Risk Register will summarize the proactive measures being taken to reduce or exploit the impact of the risks to the project. The Risk Register will be updated in the “Comments” column to capture interim risk management actions being undertaken to achieve the Risk Management Action (RMA) by the identified date.

8.2 Quarterly Risk Management Status Report
A Quarterly Risk Management Status Report will be prepared by the Metro Risk Manager or designee to provide management-level risk reporting. The Risk Manager will work within Program Control to coordinate/assimilate production of this report through Metro's centralized system via ProjectStatus and Oracle Primavera P6. The purpose of the report is to focus project management attention on the most important risks and to aid as a tool to develop future strategies to manage risk impacts.

8.3 Forecasting
The Risk Register, through the application of earned value (EV), is a key input to project cost forecasting, as EV calculates the total expected cost exposure from the identified threats and opportunities. EV is a predicted value of an identified threat or opportunity, calculated as the sum of the possible cost multiplied by the probability of its occurrence.

Preparing a forecast is necessary to predict the final cost of the project. When the forecast indicates the budget may be exceeded, additional management attention is
required in order to mitigate the potential overrun, identify adequate contingency provisions, or assure proper funding and/or expenditure authorizations are in place to cover the increase.

### 9.0 PROCEDURE HISTORY

<table>
<thead>
<tr>
<th>Revision Level</th>
<th>Revision Date</th>
<th>Summary of Revision</th>
<th>Approved</th>
</tr>
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<tbody>
<tr>
<td>9</td>
<td>02/20/18</td>
<td>Updated to reflect the latest risk management protocols/practices</td>
<td></td>
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<tr>
<td>8</td>
<td>9/11/17</td>
<td>Updated to reflect the latest risk management protocols/practices</td>
<td>09/13/17</td>
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<td>7</td>
<td>05/10/17</td>
<td>Updated to reflect the latest risk management protocols/practices.</td>
<td>05/25/17</td>
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<td>6</td>
<td>11/21/14</td>
<td>Added requirement for a statistical risk analysis to be performed using Monte Carlo simulation techniques for large projects valued at $100 million or more.</td>
<td>11/21/14</td>
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<td>5</td>
<td>5/27/11</td>
<td>Biennial review – Minor changes and added Executive Director Program Management title &amp; changed (CPMD) to TRANSIT PROJECT DELIVERY DEPARTMENT (TPDD)</td>
<td>05.24.11</td>
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<td>4</td>
<td>04.30.03</td>
<td>Procedure title change. Added Responsibilities for MTA Board and DEO Project Manager. Direction. Extensive editing to procedure as marked.</td>
<td>04.30.04</td>
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<td>3</td>
<td>05.09.02</td>
<td>Reviewed as part of the annual procedure review process. Revise to conform to current practice. Replaced &quot;ENGINEERING AND CONSTRUCTION DIVISION&quot; with &quot;CONSTRUCTION PROJECT MANAGEMENT DIVISION&quot;.</td>
<td>05.09.02</td>
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<tr>
<td>2</td>
<td>04/07/97</td>
<td>Revise 1.0 Policy; Transfer section 4.1.4 Assess Design Allowance to PRCL3 Cost Estimating, Revise sections 4.1.3 and 4.1.4; and 4.2: Add section 4.2.1 Project Reserve; define Contingency Management requirements in 4.2 Project Implementation Phase; renumber paragraphs. Replace &quot;Engineering Management Consultant&quot; with &quot;General Engineering Consultant&quot;; and add references to section 6.0 References. Updates as noted in the right margin. Ref: R92-PM200-PCN-4.00</td>
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<td>1</td>
<td>12/03/96</td>
<td>Completely revised and rewritten to reflect current MTA practices. Modifications noted in the right margin. Ref: R92-PM200-SBCN-3.00</td>
<td>01/29/97</td>
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<tr>
<td>A</td>
<td>09/01/95</td>
<td>New Procedure - Responsibility transferred from MTA Administration to the Construction Division (Configuration Mgmt.) Ref: R92-PM200-SBCN-1.00</td>
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<td>As environmental issues are likely to be present during tunnel construction SOV quantities may be exceeded. For example: truck queuing on busy streets; dust; track-out of muck spill; stormwater protection.</td>
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### SCC 10 GUIDEWAY & TRACK ELEMENTS

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<th>Risk Owner</th>
<th>Mgt Strategy</th>
<th>Action Items</th>
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<td>Low (1)</td>
<td>Rajni Patel</td>
<td>Mitigate</td>
<td>1. Strict compliance of MMRP requirements. 2. Review of RCC plans and activities. 3. Outreach to stakeholders. 4. Meeting weekly with Bonaventure to share work plans and discuss concerns/requests. 5. Interface with other Flower Street stakeholders to discuss on-going plans and issues.</td>
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<td>1. Plan for encounter based on TBM drives through the area. 2. Consider T&amp;M admin through impact areas.</td>
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### SCC 20 STATIONS, STOPS, TERMINALS, INTERMODAL

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