

**FEDERAL TRANSIT ADMINISTRATION
PROJECT MANAGEMENT OVERSIGHT PROGRAM**

**SPOT REPORT # 2
RISK ASSESSMENT AND RISK
MANAGEMENT STUDY**

EAST SIDE ACCESS PROJECT

New York City, New York – FTA Region II

Contract No. DTFT60-04-D-00012 Project No. DC-03-5704

METROPOLITAN TRANSPORTATION AUTHORITY

Prepared by
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Project Management Oversight Consultant

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LIST OF ACRONYMS

ATC	Automatic Train Control
BCE	Baseline Cost Estimate
CDF	Cumulative Distribution Function
CIL	Central Instrument Location
CLT	Central Limit Theorem
CPP	Contract Packaging Plan
DEIS	Draft Environmental Impact Statement
EIS	Environmental Impact Statement
EPC	Engineering-Procurement-Construction
ESA	East Side Access Project
FD	Final Design
FEIS	Final Environmental Impact Statement
FICA	Federal Insurance Contributions Act
FFGA	Full Funding Grant Agreement
FMOC	Financial Management Oversight Consultant
FTA	Federal Transit Administration
GAN	Grant Anticipation Note
GCT	Grand Central Terminal
GEC	General Engineering Consultant
IPS	Integrated Project Schedule
JPA	Joint Participant Agreement
LD	Liquidated Damages
LIRR	Long Island Railroad
LONP	Letter Of No Prejudice
MNR	Metro North Railroad
MTA	Metropolitan Transportation Authority
MTACC	Metropolitan Transportation Authority – Capital Construction
NEPA	National Environmental Policy Act
NTP	Notice to Proceed
NYAR	New York and Atlantic Railway
NYCDOT	New York City Department of Transportation

EXECUTIVE SUMMARY

PURPOSE

The Federal Transit Administration (FTA) assigned Urban Engineers, Inc. (Urban) to develop a Risk Assessment and Mitigation Report on the East Side Access Project (ESA) being constructed by the New York Metropolitan Transportation Authority (MTA). The Report follows Guidance 22 issued on December 8, 2003.

The purpose of this report is to provide FTA with the findings of our risk assessment study, indicating areas where the risk is highest, and perform a risk mitigation study in conjunction with the Grantee to implement measures to reduce the risk. The study addresses each of the above in the body of this report.

PROJECT SCOPE

The ESA project is one of the largest capital improvement projects undertaken by the New York MTA. The project is planned for development without independent operating segments or partial beneficial completion. The project involves the construction of approximately 5,500 feet of a new tunnel from the Long Island Rail Road (LIRR) main line in Sunnyside, Queens, to the Bellmouth at the east end of the existing 63rd Street Tunnel located at Northern Boulevard in Queens, New York. In Manhattan, approximately 5,000 feet of new twin single-track tunnels will be constructed to allow LIRR trains to move from the western portal of the 63rd Street Tunnel traveling under Park Avenue into a new terminal to be constructed below the lower level of the existing Grand Central Terminal (GCT). Overall, the ESA project will include approximately seven miles of track over 3.5 route-miles.

The ESA project includes the design, procurement, and installation of all track, signal, communications, traction power, life safety work and systems, and real estate and real estate easement acquisitions to support this new LIRR service. The LIRR's new boarding platforms will be located on two levels approximately 90 feet below the existing lower level of GCT. The deep station construction concept is intended to lessen interruption to passengers and Metro-North Railroad (MNR) operations, and eliminate the need for the underpinning of high-rise structures located along the Park Avenue alignment. A new passenger station is planned for construction in Sunnyside, Queens.

The ESA project scope and budget also include the procurement of 180 additional electric rail cars for LIRR to support the new ESA service. In order to maintain and temporarily store these cars, a vehicle maintenance facility is under construction in LIRR's Arch Street Yard area as well as a mid-day storage yard at an adjacent property owned by MTA.

In the PMOC's opinion, the scope of the project is consistent with the Record of Decision.

PROJECT COST

The PMOC has reviewed the ESA's 1999 baseline cost baseline estimate (BCE) and revisions dated June 2002, December 2003 and August 2004 and compared major contract components. In addition, we performed a detailed examination of the cost estimates of contracts CM008, CM009 and CQ031. The three contract estimates contained a high degree of detail, with quantities developed for most of the significant contract work items. No attempt was made by the PMOC to verify the accuracy of quantities. The estimates were all based on 2002/2003 labor/benefit and equipment rates, material, and subcontractor prices. Payroll taxes were applied to the labor cost at the rate of 14.85% (covering FICA and unemployment). The estimates include allowances for labor shift differential/overtime premiums where appropriate.

ESA escalated the estimated costs by 3% per year to 2004 dollars for inclusion in its August 2004 Estimate, which also includes pre and post bid contingency, as well as escalation at 3% per year from 2004 to the midpoint of construction.

The PMOC believes that ESA has used appropriate methodology to formulate its project estimate. The greatest level of concern is the 8-year project duration with associated potential for cost increases.

PROJECT SCHEDULE

The ESA's April 2004 Integrated Project Schedule (IPS) showed the project completion date as June 2012. This schedule was predicated on having an agreement with Amtrak in 2004. ESA's August 2004 revised schedule shows an August 2012 end of Pre-Revenue Service Testing date with 134 calendar days of negative float. ESA developed a revised Contract Packaging Plan (CPP), Revision 5 using an updated strategy and issued it to the FTA and the PMOC for review in April 2004.

PMOC reviewed the ESA's Integrated Project Schedule (IPS) for reasonableness of scope, time and risk. The IPS identifies major components of the project. Each contractor will prepare a detailed schedule based on the IPS which will validate durations and inter-relationships.

In the PMOC's opinion, the IPS schedule represents a reasonable breakdown of work tasks and inter-contract relationships.

RISK ASSESSMENT

PMOC performed a risk assessment using a five point triangular distribution method, based on the ranges for the costs discussed with the ESA during a workshop, held on October 5th and 6th, 2004.

The analysis shows that the project, with its current level of funding, has a 78% chance of finishing within budget. Figure 1 shows the histogram and Figure 2 and Figure 2A shows the Cumulative Distribution Function (CDF) of the simulated costs.

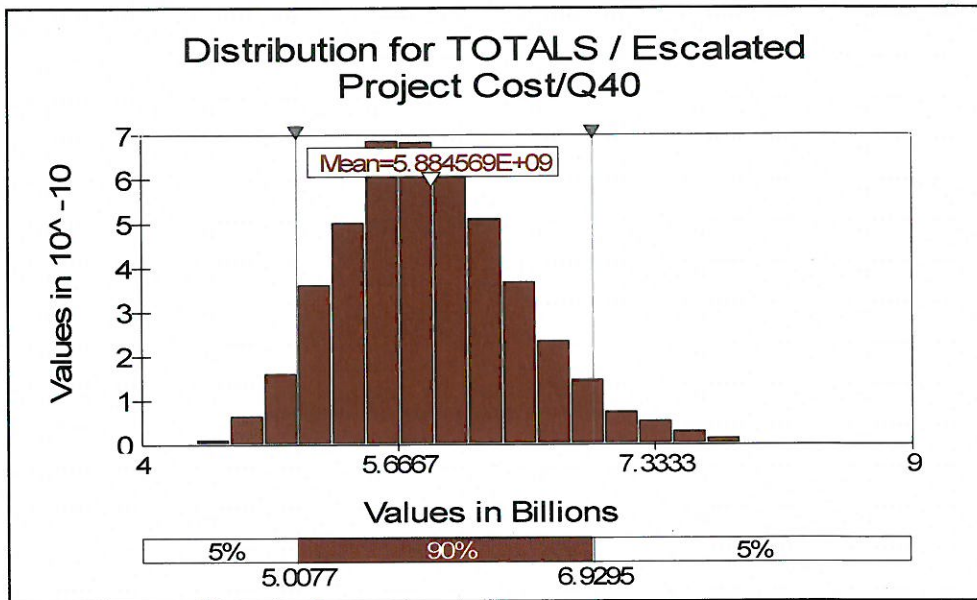


FIGURE 1 – The Histogram of Total Project Costs

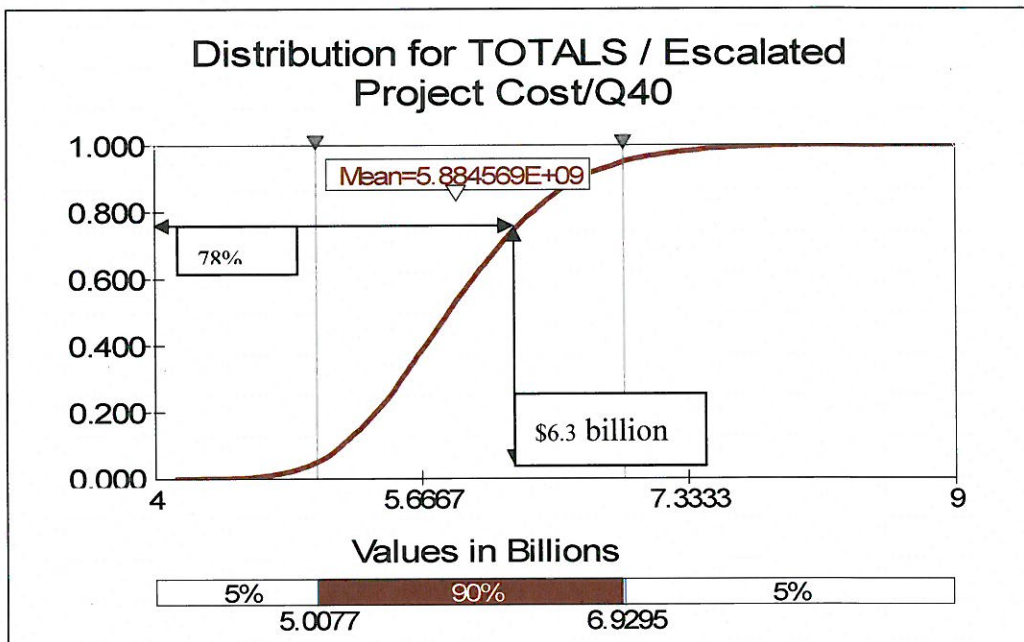


FIGURE 2 – The CDF of Total Project Costs

Confidence Level

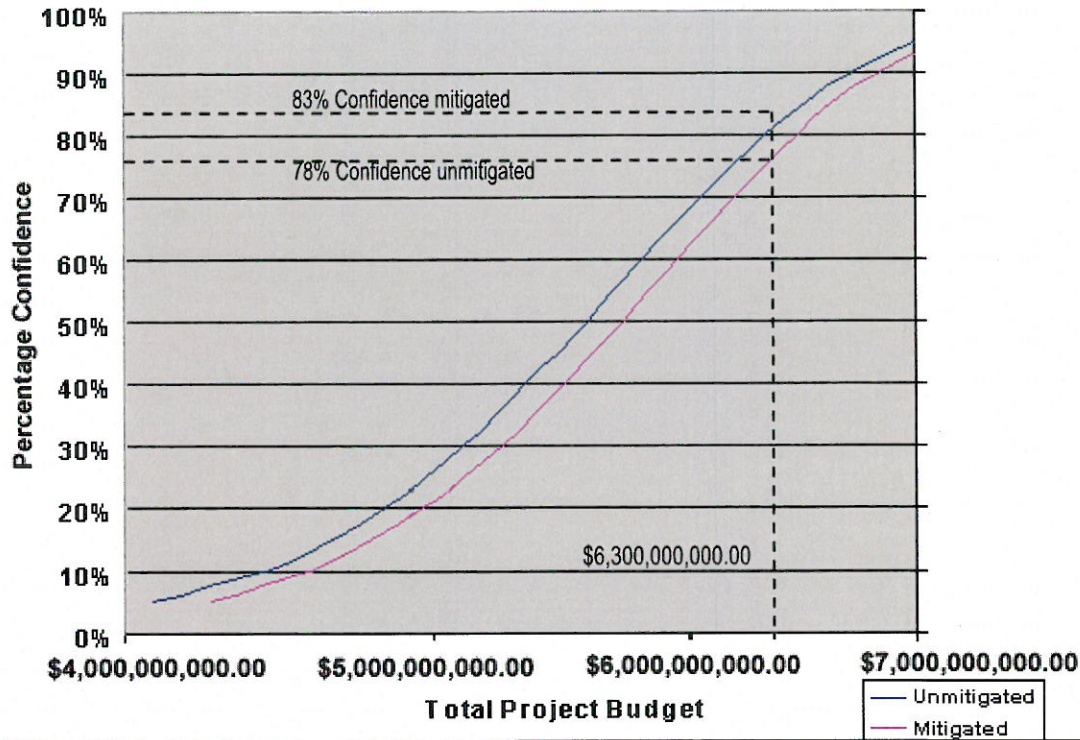


FIGURE 2A

CONTINGENCY

The project contingency consists of various elements that ESA has established and allocated to line items in the budget, as well as a pool of unallocated contingency. The following table outlines the contingency allocated to the budget line items.

	Contingency Type	\$ M
1	Construction contracts pre-bid contingency	309.5
2	Construction contracts post-bid contingency	256.3
3	Access & Protection contracts contingency	15.4
4	Engineering contingency	2.0
5	Program Management contingency	22.0
6	Management Reserve	152.7
	Total	757.9

TABLE 1

The total contingency, \$757.9 million, represents approximately 12% of the total project budget of \$6.3 billion. The PMOC has used information contained in the August 2004 estimate in order to extract this total and its components (shown in items 1 through 6

above). It should be noted that Attachment 3 of the FFGA, prepared by the ESA team, shows a total of \$802.5 million in project contingency (12.7% of the \$6.3 billion budget).

There is a 78% confidence level that the budget will be met, which indicates that there is a 22% chance the budget will overrun. The major uncertainty in the budget is the escalation.

In the PMOC's opinion, the level of contingency is adequate for the scope of the project and the current status of the project.

RISK MITIGATION WORKSHOP

A Risk Mitigation Workshop was held on October 14, 2004. Members of the ESA project team, as well as the FTA and the PMOC, were in attendance. The group reviewed the top 10 risks identified by the risk assessment process and discussed mitigation strategies.

The results of the simulation for the mitigated items are shown in Figure 3 which identifies risk profiles for pre-mitigation and post-mitigation analyses. Based on our analysis, the probability of cost overrun after mitigation is reduced from 22% to 17%, *i.e.*, there is an 83% probability that the \$6.3 billion budget is sufficient to execute the ESA Project.

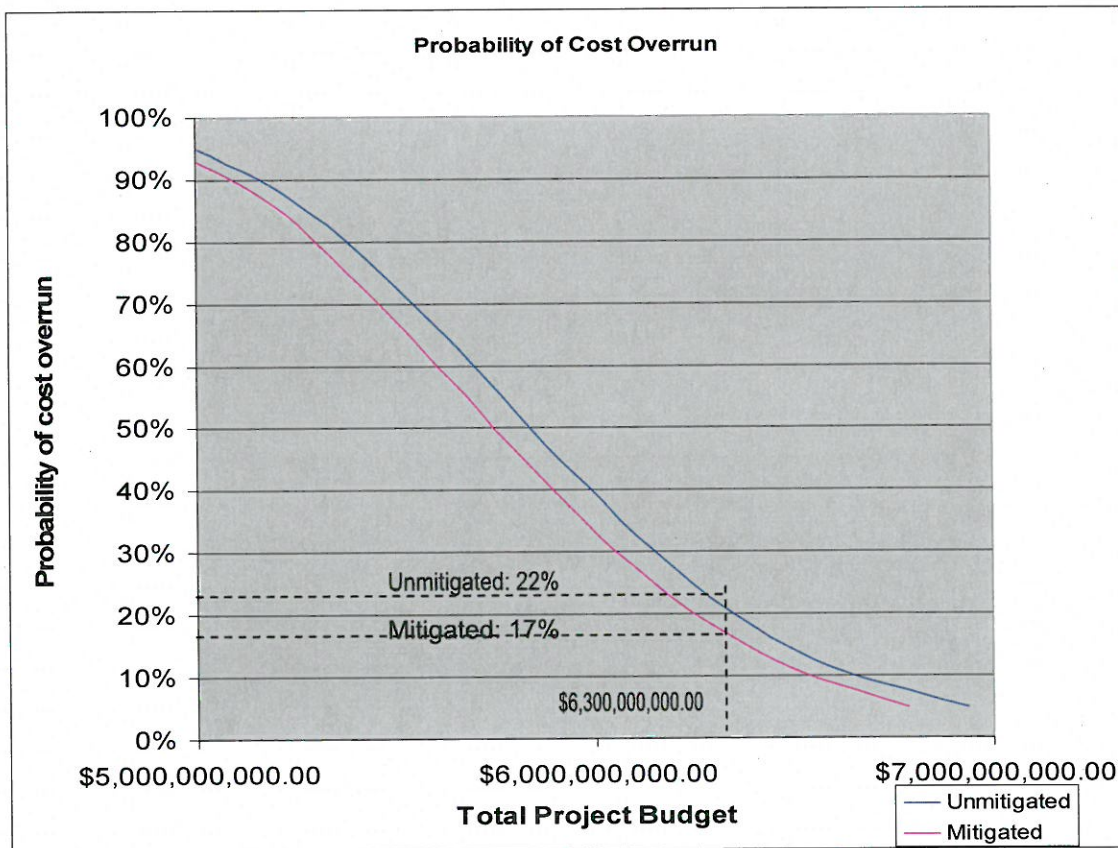


Figure 3 – Risk Profiles Before and After Mitigation

The top 15 project risks identified during the Risk assessment process are noted in the table below:

Top 15 Project Risks

1	Project-wide		Cost escalation
2	Project-wide	5-000-04	Unit cost increase for rolling stock
3	CM015	1-015-03	Building owner opposition to property taking
4	Project-wide	5-000-05	OCIP - Change in coverage
5	Harold	3-000-14	Change in alignment due to AMTRAK
6	CS079	4-079-05	Lack of competition
7	Harold	3-000-07	Lack of AMTRAK resources
8	CM09	1-009-01	Differing Site Condition
8	CM012	1-012-01	Increased blasting restrictions due to MNR concerns
8	CQ031	2-031-03	TBM unable to mine ground to meet schedule
11	Project-wide	5-000-01	Steel price increase
12	Project-wide	5-000-02	New security requirements from MTA
13	CM014	1-014-03	MTA establishes unified ops policy
14	CM014	1-014-01	Inadequate access to caverns
15	CM09	1-009-02	TBM unable to mine ground to meet schedule

SCHEDULE RISK ANALYSIS

Figure 4 illustrates the cumulative distribution function (CDF) for the project completion date. It can be seen that there is an 80% probability that the finish date will be on or before October 2, 2012. The earliest simulated finish time is April 26, 2012, and the latest simulated finish time is February 11, 2013. It needs to be stressed that the probability of these extreme values being realized is close to zero. The standard deviation for the project finish time is simulated as 40 working days. For a project of this size, this value is small and is an indication that the potential variables detected do not vary the completion date to a large degree.

Figure 4 – Cumulative distribution for finish time

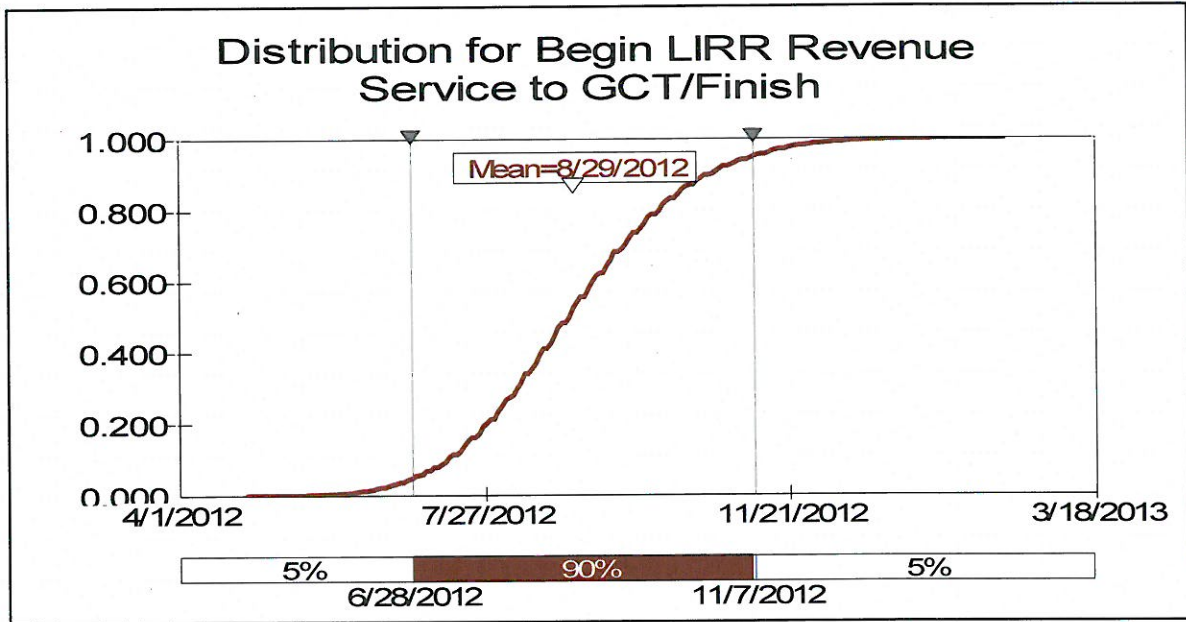
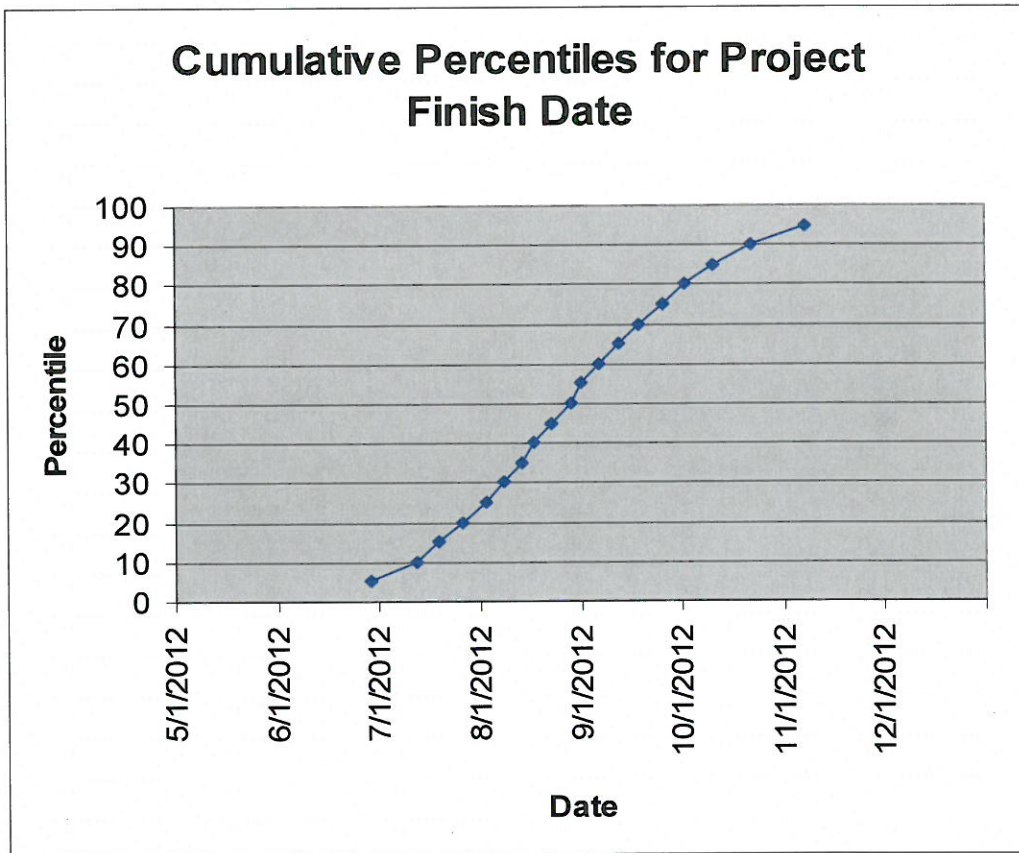


Figure 5 below shows the cumulative time for the project finish with the probability of completion.

Figure 5 – Cumulative Percentiles for Project Finish Date



CONCLUSIONS

Based on the analysis performed, and with the assumptions that are outlined in this report, the PMOC makes the following conclusions:

- Based upon its sampling of the grantee data and corresponding engineering analysis, it is the PMOC's opinion that the project scope as outlined in the Contract Packaging Plan for the East Side Access Program is consistent with the Record of Decision, sufficiently complete to support the level and quality of revenue service typically offered by the grantee, constructible and cost-effective.
- The project is in various phases of design and design development. Some contracts have been completed, some are in the bidding phase, and some contracts are still in the fifteen percent design stage. Based upon the contracts that have been bid and reviewed by the PMOC, the contract plans are adequate in terms of content, presentation, clarity, cross referencing and detail. In its Risk Analysis, the PMOC took into account areas where there are possible interface issues. The roles and responsibilities of contractors versus those of the authority (staff and any consultant support) are well defined. The grantee has chosen an appropriate level of technology that is consistently applied in systems descriptions and designs.
- Based upon its sampling of the grantee data and corresponding engineering analysis, it is the PMOC's opinion that the Baseline Cost Estimate (or Project Cost Estimate as appropriate) is mechanically correct and complete, consistent with the project scope adopted in the Record of Decision (amended as appropriate) and free of any material inaccuracies or incomplete data. It is also consistent with relevant, identifiable industry or engineering practices, uniformly applied by the grantee's cost estimators and consistent in its method of calculation.
- The PMOC's risk analysis determined that there was a 78% probability that the project would beat the budget, based on the risks that were identified by the ESA. As stated in the assumptions, the PMOC used the risks developed by the project team in the analysis. The 78% level is determined by the PMOC to be acceptable based on the length, size and scope of the project.
- The PMOC's schedule simulation determined that there is an 80% probability that the finish date will be on or before October 2, 2012. Based on a project with a duration of over 8 years, we believe that an 80% confidence level for an October 2012 completion date is reasonable.
- A Mitigation Workshop was held, the top 10 risks were evaluated and a determination made on the ability to mitigate those risks. Based on the results, the confidence level rose to 83% that the project would be completed within the project budget.

PROJECT BACKGROUND

PROJECT DESCRIPTION

- **General Description:** The ESA project is a new commuter rail project that will result in a strategic improvement in regional passenger mobility for Long Island, Eastern Queens, and Midtown Manhattan. The ESA project received a “recommended” rating in the FTA Annual Report on New Starts for 2004. FTA gave approval for the project to enter into Final Design in February 2002. Construction started at a low activity level in the fourth quarter of 2001.
- **Length:** The project alignment will include approximately 3.5 route miles of double track.
- **Number of Stations:** Two stations are planned. A new Long Island Rail Road (LIRR) terminal will be constructed below the existing Grand Central Terminal (GCT) operated by Metro-North Railroad (MNR). Elevators and escalators will connect a new LIRR concourse in the GCT to an underground station located approximately 90 feet below the concourse level. The eight boarding platforms, four upper and four lower, will be accessed from an intermediate mezzanine. A new passenger station is also planned for Sunnyside, Queens.
- **Additional Facilities:** Additional facilities will include new entrances at the existing GCT, a daytime storage and running repair shop facility in Queens, and ventilation facilities in Manhattan and Queens.
- **Vehicles:** The scope and budget for the ESA project include procurement of 180 electric rail cars to support the revenue service in 2012.
- **Ridership Forecast:** MTA estimates that, by 2020, the ESA will handle approximately 162,000 daily riders into and out of GCT.

PROJECT ORGANIZATION

The East Side Access Project (ESA) is one of a series of projects being managed by the New York Metropolitan Transportation Authority Capital Construction (MTACC), a subsidiary of the New York Metropolitan Transportation Authority (NYMTA).

The ESA organization manages most aspects of the design and construction of the project, the exception being Right-of-Way, which is a function of NYMTA. The ESA management team includes a Project Management Team (PMT) made up of its own staff as well as consultants engaged for staff augmentation. The PMT also includes a design engineering consultant.

PROJECT STATUS

On December 31, 2002, the FTA granted approval through a Letter of No Prejudice (LONP) for the project to commence construction of the Manhattan Tunnels, Queens Open-Cut

Tunnels, Demolition of the 44th Street Building, and Wood Interlocking. However, the MTA did not authorize the start of procurement activities on those contracts. In part, the MTA's deferment of advancing construction was to re-evaluate the expected cost of the ESA project and to evaluate future Capital Program budget plans. The MTA has stated that, with some progress in the Amtrak negotiations, award of the Manhattan and Queens Tunnels contracts could progress. However, the contracts related to the Harold Interlocking must be reviewed and concurred by Amtrak prior to starting construction.

In July 2002, the Project Management Team (PMT) completed Preliminary Engineering (PE) for all applicable phases of the project; however, there are still portions of project design that remain in conceptual design or early PE development. Further, in April 2003, portions of the final engineering tasks related to civil engineering and signal architecture in Queens were directed to stand-down due to the lack of information needed from Amtrak. Alternate design task assignments were made by the PMT in an attempt to continue with design production.

Construction execution strategy includes a phased engineering-procurement-construction (EPC) method. This method represents multiple activities working in parallel while preserving the traditional fixed price contracting and bidding method of complete design packages. Construction was initiated in the fall of 2001 with the start of the early-build project at Highbridge Yard in Bronx, New York. Other early-build contracts have included the following:

- Arch Street Yard and Shop in Queens;
- Demolition of the Superior Reed Building and Existing Rail Yard in Queens;
- Queens Open-Cut Excavation at the 63rd Street Bellmouth in Queens;
- Manhattan Approach Tunnel excavation;
- Switch and Panel Exchange System Equipment procurement;
- GCT East Yard Environmental Remediation in Manhattan; and
- GCT and East Yard Track and Systems Modifications also in Manhattan.

The current Integrated Project Schedule (IPS) submitted to the FTA and the PMOC for review early in April 2004 shows the project completion date in June 2012. This schedule is reported by the PMT to be predicated on having an agreement with Amtrak in June 2004. A revised Contracting Packaging Plan (CPP), revision 5 using updated strategy, was developed by the MTACC, issued to the FTA and the PMOC for review in April 2004, continues to be revised by the MTACC and issued with new developments. The PMOC has reviewed the revised IPS and CPP and provided comments in June 2004

The FTA approved entry into PE in September 1998 and it was declared substantially complete in January 2001 by the PMT with the exception of GCT. The PMT reported that the preliminary engineering for GCT was completed in May 2002.

The FTA issued a Record of Decision (ROD) in May 2001. The FTA approved entry into Final Design in February 2002. Final Design will progress concurrently with the construction phase as is shown in revision 5 of the CPP.

Construction of the design-build work at the Highbridge Yard, one of ESA's early-build segments that had to be completed before starting work in the Madison Yard area of GCT, started in September 2001 and substantial completion was reached in December 2003.

The FTA issued a LONP for the Arch Street Yard and Shop Facility in April 2002. Construction started in October 2002. Substantial completion originally forecasted for September 2004, is now forecast for December 2004, due to design changes of track arrangement and the electrical substation.

Work on the Queens Open-Cut Excavation contract at the existing 63rd Street Tunnel Bellmouth began in October 2002. Substantial completion was achieved in November 2003. Project closeout and punch list activities were completed in April 2004.

Demolition work on the Superior Reed Building started in December 2002, with substantial completion in September 2003, and final completion in October 2003. Punch list items and close-out activities were completed in April 2004.

The Notice to Proceed (NTP) for the Switch and Panel Exchange System Equipment procurement contract was issued in December 2002. The contract work is reported to be progressing according to schedule. Contract completion is expected in November 2004.

The NTP for the Manhattan Approach Tunnel Excavation work was issued in February 2004. Utility work in preparation for excavation was completed ahead of schedule. Roadheader mining activity started as scheduled on June 21, 2004. The PMT terminated the contract in July 2004 due to poor mining production.

The FTA issued a LONP for the Manhattan Tunnels Excavation, Queens Open-Cut Excavation, demolition of the 44th Street Building, and installation of Wood Interlocking on December 31, 2002. However, the procurement process was delayed by the MTA while evaluating the overall MTA capital program budget and ESA project's cost estimate. The solicitation and procurement process for these contracts was planned to commence in early 2003, in order to facilitate a construction start in early 2004. Negotiations with Amtrak have not progressed as anticipated, causing some delay to construction starts of major contract packages. The Manhattan Tunnel Excavation contract package (CM009) and the Queens Open Cut Excavation and Tunnel contract (CQ028) originally scheduled for award in January 2003, are currently awaiting contract award.

The target pre-revenue service testing completion date is June 30th 2012. Although the strategic project completion in 2012 depends on many issues, two factors have a significant influence on future performance of the master project plan. The first is the funding plan for the project which must be sustainable over the two MTA Capital Program periods, 2000 – 2004 and 2005 - 2009. The second is that an agreement with Amtrak needs to be reached in 2004 in order to support the revised IPS. Technical discussions with Amtrak commenced in January 2004 and are on-going. There is an initial agreement with Amtrak in place.

ESA has executed an agreement with Amtrak relating to environmental issues, which allows access for surveying and soil boring activities in the rail yards. An agreement will have to be executed for Amtrak's review of Harold design products as well as force account resources as required for the project.

ENVIRONMENTAL ASSESSMENT AND RECORD OF DECISION

On May 21, 2001, FTA made a determination in its Record of Decision (ROD) as follows:

On the basis of the environmental record analyzed for the project, the evaluations of social, economic, and environmental impacts as presented in the FEIS; the summary of committed mitigation for East Side Access (see Mitigation Measures section below); and the written and oral comments offered by the public and other agencies, the FTA has determined, in accordance with 49 USC Section 5324(b), that;

- *An adequate opportunity was afforded for the presentation of views by all parties with a significant economic, social, or environmental interest in the Project;*
- *The preservation and enhancement of the environment and the interest of the community in which the proposed Project is located was considered; and*
- *No feasible and prudent alternative to the adverse environmental effects of East Side Access exists and all reasonable steps have been taken to minimize the effects.*

The State Historic Preservation Officer (SHPO) has determined that the East Side Access Project will have no significant adverse effects, subject to the conditions listed in the Programmatic Agreement included in Appendix B to the FEIS, on historic or archaeological resources. This includes several areas identified as having the potential to contain archaeological resources and the historic properties located in the Project's area of potential effect. Within the area of potential effect there is one historic property, Grand Central Terminal, which is a National Historic Landmark, and 17 historic resources in Manhattan (including Grand Central Terminal) and three historic resources in Queens that are either listed on the State and National Registers of Historic Places or eligible for such listing.

Pursuant to 23 CER Section 771.129, if it becomes necessary to make significant changes to the scope of the Project, or if major steps to advance the Project have not been taken within three years, a written evaluation of the FEIS for East Side Access will be required before further approvals may be granted. Additionally, as part of any procurement contracts for the Project, MTA/LIRR East Side Access must commit to carry out the mitigation measures described in the FEIS and herein.

At this point in time, no significant changes have been necessary and the ESA has taken major steps to advance the project.

METHODOLOGY

REQUIREMENTS

FTA issued its latest “**Draft Guidance Number 22 – Risk Assessment**” on December 8, 2003. According to the Guidance, the PMOC will perform four tasks as follows:

Subtask No. 22 A – Review of Grantee Scope, Schedule and Cost

The contractor as directed in the specific task order shall review grantee documentation, characterize the grantee’s cost estimate and project schedule and either validate the grantee performed review of scope, schedule and cost or perform its own review in conformance with these procedures. This task is distinct from the Baseline Technical Capacity and Capability Review.

Subtask No. 22 B - Risk Assessment

The contractor as directed in the specific task order shall develop a risk register inclusive of unit cost and quantity risks and either validate the grantee performed risk assessment of project scope, schedule and cost or perform its own risk assessment in conformance with these procedures.

Subtask No. 22 C - Review of Grantee Project Contingency

The contractor as directed in the specific task order shall determine the reasonableness of the grantee’s project contingency in conformance with these procedures.

Subtask No. 22 D - Risk Mitigation

The contractor as directed in the specific task order shall validate the grantee performed risk mitigation of the identified project risks and make recommendations as to mitigation strategies in conformance with these procedures. The contractor shall make recommendations as to specific LONP/FFGA special provisions that would address elements that can be mitigated and identify same in the risk assessment.

BASIS AND ASSUMPTIONS

FTA requested that this report be prepared quickly, which meant the time frame for its completion was compressed. Accordingly, the PMOC made certain assumptions in order to assess the scope and determine the confidence levels for both the project schedule and budget in the time allowed. The PMOC made the following assumptions:

- The PMOC used the Contract Packaging Plan (CPP) to ascertain that it complied with the scope requirements defined in the FEIS. PMOC assumed that the CPP contained all scope elements required for project completion.
- PMOC used ESA’s August 2004 Project Estimate as the current baseline for its review of project budget and contingency.

- PMOC assumed that the rate of escalation would be 3.5%.
- PMOC analyzed the contract cost based on the latest IPS, with its assumed contract start and finish dates.
- The PMOC used the risks identified by the ESA as a basis for its analysis. Additional risks were added as a result of the review of the CPP.
- The PMOC developed a schedule based on information provided by ESA. The August 2004 updated schedule indicated a December 2012 project completion. During the mitigation workshop, the FTA directed that we use this date for the schedule risk analysis.

APPROACH – SUBTASK 22A

The Review and Analysis of Grantee Scope, Schedule and Cost section of this report describes the PMOC's review of the project to establish whether:

- The Project Scope is substantially consistent with that adopted in the Record of Decision and sufficiently complete to support the level and quality of revenue service typically offered by the grantee; plans and drawings are adequate, constructable and cost-effective; major work details are well defined; and roles and responsibilities of staff and contractors are well defined
- The Project Cost Estimate is mechanically correct and complete, consistent with the project scope adopted in the Record of Decision and free of any material inaccuracies or incomplete data
- The Project Schedule is mechanically correct and complete, consistent with the project scope adopted in the Record of Decision and National Environmental Policy Act (NEPA) documents as applicable and the proposed Revenue Operations Date as well as being free of any material inaccuracies or incomplete data
- The Grantee has matched the appropriate technology with the planned transit applications for the best performance at the lowest cost
- The Grantee effectively and efficiently manages project risk and the resultant risk profiles represent identifiable, known risk factors with acceptable levels of variability.

APPROACH – SUBTASK 22B

The Risk Analysis and Assessment section of this report (page 62) describes the results of the PMOC's independent risk assessment of the ESA's estimated cost and schedule for this project. The study utilizes a probabilistic approach for the cost risk assessment.

Uncertainties in the total project cost and schedule for this project are evaluated for each individual Baseline Cost Estimate (BCE). Each BCE reflects a contract unit as identified in the Contract Packaging Plan. For each BCE a number of risk factors have been

identified and the range of potential impact for each risk factor has been elicited from persons most knowledgeable about the project.

The probabilistic risk assessment for this project was conducted by ranging the cost of risk factors. Appropriate probability distributions were used to model these risks; namely triangular distributions after the FTA's Guidance No. 22. These distributions were used in two different ways. First a non-simulation approach was used by utilizing the Central Limit Theorem to calculate the distribution of the total project cost. Then a Monte Carlo simulation analysis was conducted by modeling risk factors as random variables and obtaining the distribution for the total cost. For both methods the effect of correlation among random variables was considered. The results of both simulation and non-simulation approaches are very close and corroborative.

Having the distribution of cost for the total project, one can calculate the probability of cost overrun by comparing the project budget with the simulated distributions. Also, the effect of various risk factors on total project budget can be quantified and risk factors can be ranked. Another by-product of the probabilistic risk assessment is an objective contingency analysis. Using the total cost distribution, one can establish a contingency level such that the probability of project cost overrun remains below a specified level.

APPROACH – SUBTASK 22C

The review of Grantee Project Contingency section of this report describes and analyzes the grantee's contingencies. The review addresses allocated and unallocated contingencies for consistency with relevant, identifiable industry practices and analyzes the grantee use of allowances versus contingency. The PMOC will review the reasonableness of the project contingency (allocated and unallocated).

APPROACH – SUBTASK 22D

The Risk Mitigation section of this report describes the risk mitigation factors reviewed in a combined PMOC/Grantee workshop and joint recommendations made as to mitigation strategies. The workshop used the risk analysis performed in Subtask 22B to identify the ten most critical risks that could impact project cost.

GRANTEE DOCUMENTATION REVIEW PLAN

FTA Guidance Number 22 (Draft) requires the PMOC to “*select an appropriate amount of relevant documentation, determine its validity and incorporate that data into the contractor's opinion and delivered products*”.

The PMOC has reviewed the following documents:

- The FTA Record of Decision
- ESA's Project Management Plan
- The ESA's August 2004 Cost and Schedule reports
- ESA's Risk Assessment Report
- Baseline and revised cost estimates

- ESA's Contract Packaging Plans
- PE Drawings
- FEIS
- ESA's Revised Schedule dated October 2004

EVALUATION TEAM

Urban chose an evaluation team that included professionals with expertise in construction estimating, civil design, systems design, vehicles, project management, and quality. This broad spectrum of expertise stimulated comments and input covering all aspects of the project. The team members met with the Grantee, which participated in determining the level of risk of each identified risk element. The make-up of the evaluation team is shown below:

**Federal Transit
Administration**

John Susino
Steve Bhattacharya

Urban Engineers Inc.

William Thomsen
Brian Stover
Marty Izaak
Al Alberts
Alan Pizzi
Ali Touran
Burt Kohlman
Mike Weatherell
Victor Simuoli
Gerald White

MTA/NYCT

Dilip Patel
Michael Curran
George Blank
Jerry Gold
Shawn Kildare
Alan Paskoff
Doug Champlin
Michael Marino
Robert Spero
Robert Magnifico
Jesus Schabib
Peter Hankovszky
Kent Hoggas
Paul Lucas
Roger Roseborough
Mark DeBernardo
Vinny Kissoon
Sterling Brisbin
Audrey Heffernan
Lori Katzman
Susan Jurman
Dan Louis
Steve Lee
Mysore Nagaraja

PROJECT BASELINE COST AND SCHEDULE

CHARACTERIZATION OF GRANTEE COST AND SCHEDULE

PROJECT BUDGET

The original budget, established in the fall of 1998, was \$4.3 billion based as a conceptual budget estimate, which contained the Major Investment Study and the alternatives analysis. In the fall of 2001, an overall program budget of \$4.35 billion was based on the preliminary engineering documents completed through Phase I and Phase IA. In September of 2002, the PMT issued Revision 2 of the Cost Estimate, which increased the overall program cost from \$4.35 billion to \$5.015 billion. An additional \$250 million was allocated for management reserve, bringing the total project estimate to \$5.265 billion. In December 2003, the MTACC issued yet another revision to the project estimate, which reflected its involvement and the project re-organization, increasing the project cost to \$6.3057 billion.

PROJECT SCHEDULE

The ESA's April 2004 Integrated Project Schedule (IPS) showed the project completion date as June 2012. This schedule was predicated on having an agreement with Amtrak in 2004. ESA's August 2004 revised schedule shows an August 2012 Preend of Service Testing date with 134 calendar days of negative float. ESA developed a revised Contract Packaging Plan (CPP), Revision 5 using an updated strategy and issued it to the FTA and the PMOC for review in April 2004.

Preliminary Engineering (PE): The FTA approved entry into PE in September 1998 and it was declared substantially complete in January 2001 by the PMT with the exception of GCT. The PMT reported that preliminary engineering for the GCT was completed in May 2002.

Record of Decision (ROD): The FTA issued the ROD in May 2001.

Final Design (FD): The FTA issued a Record of Decision (ROD) in May 2001. The FTA approved entry into Final Design in February 2002. Final Design will progress concurrently with the construction phase as is shown in Revision 5 of the CPP.

Construction of the design-build work at the Highbridge Yard, one of ESA's early-build segments that had to be completed before starting work in the Madison Yard area of GCT, started in September 2001, and substantial completion was reached in December 2003 (Contract CM001).

The FTA issued an LONP for the Arch Street Yard and Shop Facility in April 2002. Construction started in October 2002. Substantial completion, originally forecasted for September 2004, is now forecast for December 2004 due to design changes of track arrangement, changes to the car hoist, Stinger System and the electrical substation (Contract CQ027).

Work on the Queens Open-Cut Excavation contract at the existing 63rd Street Tunnel Bellmouth began in October 2002. Substantial completion was achieved in November 2003. Project close-out and punch-list activities were completed in April 2004 (Contract CQ026).

Demolition work on the Superior Reed Building started in December 2002, with substantial completion in September 2003, and final completion in October 2003. Punch-list items and close-out activities were completed in April 2004 (Contract CQ025).

The Notice-to-Proceed (NTP) for the Switch and Panel System Equipment procurement contract was issued in December 2002. The contract work is reported to be progressing according to schedule. Contract completion is expected in November 2004 (Contract VH055).

The NTP for the Manhattan Approach Tunnel Excavation work was issued in February 2004. Utility work in preparation for excavation was completed ahead of schedule. Roadheader mining activity started as scheduled on June 21, 2004. The PMT terminated the contract in July 2004 due to poor mining production (Contract CM016).

The target Pre-Revenue Service Testing completion date is June 30, 2012. Although the strategic project completion in 2012 depends on many issues, two factors have a significant influence on future performance of the master project plan. The first is the funding plan for the project which must be sustainable over the two MTA Capital Program periods, 2000 – 2004 and 2005 - 2009. Secondly, an agreement needs to be reached with Amtrak in 2004, in order to support the revised IPS. Technical discussions with Amtrak commenced in January 2004 and to date have concluded with an agreement covering environmental and other aspects of the work. Other issues must be covered in secondary agreements, including the process for design review and force account resources.

SUBTASK 22A – REVIEW AND ANALYSIS OF GRANTEE PROJECT SCOPE, COST AND SCHEDULE

PROJECT SCOPE

THE FINAL ENVIRONMENTAL IMPACT STATEMENT (FEIS) AND RECORD OF DECISION (ROD) SCOPE

The ESA project is one of the largest capital improvement projects undertaken by the New York MTA. The project is planned for development without independent operating segments or partial beneficial completion. The project will be achieved by constructing approximately 5,500 feet of a new tunnel from the LIRR main line in Sunnyside, Queens, to the Bellmouth at the east end of the existing 63rd Street Tunnel located at Northern Boulevard in Queens, New York. In Manhattan, approximately 5,000 feet of new twin single-track tunnels will be constructed to allow LIRR trains to move from the western portal of the 63rd Street Tunnel traveling under Park Avenue into a new terminal to be constructed below the lower level of the existing GCT. Overall, the ESA project will include approximately seven miles of track over 3.5 route-miles.

The ESA project includes the design, procurement, and installation of all track, signal, communications, traction power, life safety work and systems, and real estate and real estate easement acquisitions to support this new LIRR service. The LIRR's new boarding platforms will be located on two levels approximately 90 feet below the existing lower level of GCT. The deep station construction concept is intended to minimize interruption to passengers of Metro-North Railroad (MNR) and eliminate the need for the underpinning of high-rise structures located along the Park Avenue alignment. A new passenger station is planned for Sunnyside, Queens.

The ESA project scope and budget also include the procurement of 180 additional electric rail cars for LIRR to support the new ESA service. In order to maintain and temporarily store these cars, a vehicle maintenance facility is under construction in LIRR's Arch Street Yard area as well as a mid-day storage yard at an adjacent property owned by MTA.

PROJECT SCHEDULE

ESA'S PRIMARY SCHEDULE

The ESA prepared the baseline project schedule, referred to as the Initial Project Schedule (IPS), which is utilized to plan and monitor progress on the numerous project elements. We used the latest update of August 1, 2004 for our review.

The IPS is intended to be an overall project document that integrates design, bid and construction activities into one schedule. The schedule is summary in nature, although it contains enough detail to identify interface points and milestones for monitoring progress

on the project. Other schedules are developed for detail monitoring and are utilized as stand-alone schedules. This means that the responsible parties develop and monitor and report against the detail schedule.

The PMT developed Contract Packaging Plan Revision 5.0 to be used in conjunction with schedule development that describes the major work components for the project. It identifies third party and force account work. The work breakdown structure follows a geographical classification for work in Manhattan, Queens, Harold and Project-wide. The following table indicates the number of contracts by location broken down into third-party and force account contained in the Contract Packaging Plan.

Location	Third Party	Force Account
Manhattan	11	18
Queens	11	28
Harold	7	24
Project-wide	4	7
Total	33	77

TABLE 1

PMT collects and enters information into the IPS monthly. The information from the detail schedules is input into the IPS for tracking progress. Any changes to the schedule logic are made during the first three weeks of the month and the status is entered during the last week of the month. This allows management to separate the effects of modifications from the status updates.

The construction portion of the schedule is a representation of ESA's estimates of work elements. Once a construction contractor (third party contract) has been selected and a contract executed, it will be the contractor's task to develop a baseline project schedule, which PMT will review and ultimately approve. PMT will then modify the IPS by deleting the old tasks and replacing them with suitable summary tasks for the contractor's baseline schedule. The construction schedules will be updated on a monthly basis. ESA intends to hire a staff of schedulers to monitor each individual contract schedule.

During the PMOC's review it became evident that the PMT had not included logic depicting the administrative process of obtaining the FFGA. In order to be complete, the administrative process tasks should be planned, incorporated into the project schedule and monitored.

The CM009 contract is the start of the project critical path and contains some unknowns because of the subsurface work involved. The IPS indicates CM009 will complete all boring operations before the following contract can begin. This relationship should be

investigated to determine if an opportunity exists to advance work without effecting CM009 production.

PROJECT COST

REVIEW OF ESA COST ESTIMATING METHODOLOGY

The PMOC audited a sampling of East Side Access third party contract cost estimates. We reviewed three contract cost estimates, whose total construction values represented approximately 20% of the total project construction cost of \$4.4 billion. Specifically, we examined Contract Packages CM008 – GCT Concourse Civil and Structural (\$61.5 M), CM009- Manhattan Tunnels Excavation (\$412.6 M), and CQ031- Queens Bored Tunnels and Structures (\$377.5 M).

The three contracts represent different stages of design development and/or estimating methodologies.

- 1) The CM008 estimate is based on 100% design drawings and specifications. The estimate backup documents reviewed by the PMOC were in the form of a unit price estimate, with some crew-based pricing for unusual items. PMOC did not perform a detailed analysis to estimate contractor indirect costs (general conditions); instead a percentage of direct costs was applied.
- 2) The CM009 estimate is based on 100% design stage drawings and specifications. The estimate backup documents reviewed by the PMOC were in a contractor-type, crew and production based estimate. PMOC performed a detailed analysis to determine contractor indirect costs.
- 3) The CQ031 estimate is based on Preliminary Engineering stage drawings. The estimate backup documents reviewed by the PMOC were a contractor-type crew and production based estimate. PMOC performed a detailed analysis to determine contractor indirect costs.

In general, all three estimates appeared to contain a high degree of detail, with quantities developed for most of the significant contract work items. No attempt was made by the PMOC to verify the accuracy of quantities. The estimates were all based on 2002/2003 labor/benefit and equipment rates, material, and subcontractor prices. Payroll taxes were applied to the labor cost at the rate of 14.85% (covering FICA and unemployment). The estimates include allowances for labor shift differential/overtime premiums where appropriate. The CM008 estimate package indicates that the estimate is based on a competitive bidding environment (at least 3 bidders for GC, materials, equipment, and subcontractors), and excludes allowances for abnormal market forces or “wild” market fluctuations for labor trades or materials.

The estimated costs were escalated by 3% per year to 2004 dollars for inclusion in the August 2004 ESA Project Estimate, which also includes pre and post bid contingency, as well as escalation at 3% per year from 2004 to the midpoint of construction.

The PMOC notes the following areas of concern;

- 1) There are inconsistencies in the development of contractor indirect costs; Contract CM008 uses 8% of direct cost, CM009 is estimated (in detail) at 23% of direct cost, and CQ031 is estimated (in detail) at 15% of direct cost. **These rates seem to have been redistributed for the August 2004 estimate, but in cases where a rational evaluation was not performed (such as CM008) the rate for indirect costs may be too low.**
- 2) There are inconsistencies in the development of contractor risk/profit; the heavy construction industry often relates the profit/risk as a percentage of total labor costs. **For the CM008 contract, this is approximately 21% (too low), for CM009, this is 40% (standard for this complexity of project), and for CQ031, this is approximately 38% (also standard). If many of the other estimates have ratios below the 40% range, the values for risk/profit may be too low.**
- 3) Environmental Liability insurance is not included in the estimates; if the OCIP policy does not include this, the contractor will have to carry this coverage where applicable.
- 4) PMOC checked labor wage and benefits used in the estimates against rates received from the General Contractors Association of NY. There are small positive and negative variances from rates used in the estimates, but these tend to balance to a zero sum.
- 5) The application of contingency seems to be quite variable. CQ031 uses 30% of direct and indirect costs (redistributed to be 16% of construction cost in the August 2004 estimate). CM008 uses 2% of construction cost in the August 2004 estimate. PMOC understands that some contingency may have been shifted into "management reserve" but it is not clear that each contract is properly accounted for.
- 6) Metals prices in the estimates are based on 2002 values. Although these have been escalated to 2004 dollars at the rate of 3% per year, there has actually been up to 40% escalation during that time period. **This may cause a large understatement in the materials portion of the estimates.**
- 7) Potential skilled labor shortages have not been addressed in the estimates. Housing and per diem payments may be required to attract out-of-region trades people.
- 8) Given the considerable detail devoted to most estimate items, there are a few that appear as lump sum, and therefore do not carry a high degree of confidence. Examples of these, from the CQ031 estimate, are;

Utility relocation – \$2.9 M
Plumbing – \$2.7 M
Architectural - \$1.7 M
Construction MPT - \$1.1 M

BCE COST TABLE

TABLE 2 BCEs

Contract Unit	Contract Name	Baseline Cost (\$2004 millions)
Manhattan Third Party Contracts		
CM008	GCT Concourse, Civil and Structural	53.233
CM009	Manhattan Tunnels Excavation	349.927
CM012	GCT Caverns, Tunnel Lining, 63 rd St. Tunnel Rehabilitation & Bellmouth Structure	617.128
CM013	38 th , 50 th & 55 th St. Ventilation Facilities	68.718
CM014	GCT Concourse and Caverns Finishes	280.000
CM015	GCT Surface Entrances	44.738
Queens Third Party Contracts		
CQ028	Queens Open-cut Excavation & Tunnel Under Northern Blvd.	86.902
CQ031	Queens Bored-Tunnels and Structures	270.145
CQ032	Tunnel Structure at Existing Rail Yard	78.528
CQ033	Mid-Day Storage Yard Facility	124.514
Harold Third Party and Force Account Contracts		
CH,FH,VH	All Harold contracts	536.542

Contract Unit	Contract Name	Baseline Cost (\$2004 millions)
Project-wide Third Party Contracts		
CS078	Track and Third Rail on Direct Fixation	61.733
CS079	Power, Signals, Communications and Other Systems Elements	306.826
CS081	Tunnel Ventilation Systems	92.997
	All remaining contracts including Force Account	474.420
Project-wide Costs		
	Owner-controlled Insurance (OCIP)	259.217
	Program Management	390.981
	EIS and Engineering	411.884
	Rolling stock	439.960
	Real Estate	165.000
	Escalation	419.690
	Contingency	772.677
	Total	6,305.760

RISK IDENTIFICATION FOR PROJECT AND BCE UNITS

MANHATTAN THIRD PARTY CONTRACTS

CM001 MNR Replacement Yard at Highbridge

Scope Assessment

The scope of this contract is to build replacement facilities at Highbridge for MNR. The scope is consistent with the FEIS.

Cost Assessment

This contract is substantially complete.

Schedule Assessment

This contract is substantially complete.

Risk Assessment

This contract is substantially complete.

CM004 245 Park Avenue Entrance

Scope Assessment

The scope of this contract is to construct an entrance to the GCT from 245 Park Avenue, including the procurement and installation of escalator equipment. The scope is consistent with the FEIS.

Cost Assessment

The estimate for this contract is \$4,477,007. The PMOC reviewed the entire cost estimate and found the process for the formulation of the estimate to be sound – see page 14 Review of ESA Cost Estimating Methodology.

Schedule Assessment

PMOC reviewed the ESA's Integrated Project Schedule (IPS) for reasonableness of scope, time and risk. The IPS identifies major components of the project, including this contract. The contractor will prepare a detailed schedule based on the IPS which will define durations and inter-relationships. The IPS schedule represents a reasonable estimate of work tasks and inter-contract relationships.

Risk Assessment

Risks associated with this contract include:

- Lack of MNR F/A for Direct Work
- Claiming of work by MNR unions

Note: This work is physically independent of the ESA project and hence was transferred from CM014 to its own stand-alone contract.

CM008 GCT Concourse Civil & Structural

Scope Assessment

The scope for this contract is to perform civil and structural work at the GCT in preparation for finishes work. The major work includes demolition of a building at 47 E. 44th Street; hazardous material abatement of this building; underpinning of adjacent structures; platform demolition; rail, ballast, and crash wall removal; utility relocations; and reframing for escalator ways. The scope is consistent with the FEIS.

Cost Assessment

The baseline estimate for this contract is \$53,233,035. The PMOC reviewed the entire cost estimate and found the process for the formulation of the estimate to be sound – see page 14 Review of ESA Cost Estimating Methodology.

Schedule Assessment

PMOC reviewed the ESA's Integrated Project Schedule (IPS) for reasonableness of scope, time and risk. The IPS identifies major components of the project, including this contract. The contractor will prepare a detailed schedule based on the IPS which will define durations and inter-relationships. The IPS schedule represents a reasonable estimate of work tasks and inter-contract relationships.

Risk Assessment

Risks associated with this contract include:

- Encountering unexpected utilities
- Inability of MNR to provide outages
- Lack of MNR Force Account for direct work
- Additional Hazmat removal

This contract includes civil and structural work in the Grand Central Terminal (GCT), including demolition. The accuracy of railroad as-built records of existing utilities is questionable. A risk exists for the encountering of unexpected utilities during demolition and excavation operations (1-008-01).

The work within the Grand Central Terminal (GCT) will require track outages by the Metro-North Railroad (MNR) as work is performed adjacent to existing tracks. A risk exists that MNR will not provide outages as required and planned by the contractor (1-008-02).

In addition to track outages, MNR provides force-account assistance for the removal of demolition debris by work train to a designated off-site location. A risk exists that MNR

may not be capable of providing the force-account assistance when required and planned by the contractor (1-008-03).

This contract requires demolition of a building at 47 E. 44th Street, with accompanying hazardous material abatement of this building. A risk exists that not all hazardous material has been identified and additional hazardous material removal requirements may be encountered (1-008-04).

CM009 Manhattan Tunnels Excavation

Scope Assessment

The scope of this contract includes the procurement of tunnel boring machine (TBM) equipment and the assembly and use of the equipment to excavate the tunnels in Manhattan from the existing 63rd Street tunnel to the south end of the GCT tail tracks. It also includes drill and blast excavation for the “Y” and crossover caverns. The scope is consistent with the FEIS.

Cost Assessment

The firm price bid for this contract was \$364,284,000. The ESA estimate for this contract has been confirmed by the bid process and the cost is within the budget amount.

Schedule Assessment

This contract is the start of the project critical path and contains some unknowns because of the subsurface work involved. The IPS indicates CM009 will complete all boring operations before the follow-on contract can begin. This relationship should be investigated to determine if an opportunity exists to advance other work without affecting CM009 production.

Risk Assessment

Risks associated with this contract include:

- Differing site condition
- TBM unable to mine ground to meet schedule
- Delay in obtaining construction power

This contract is tunnel excavation in Manhattan by Tunnel Boring Machine (TBM) equipment and drill and blast methods. Geotechnical information is provided to the contractor. A risk exists of a differing site condition where material encountered varies from what is known and expected, this requiring modified excavation methods (1-009-01).

The schedule for this contract will determine a production rate of tunneling operations in order to complete the project on time. A risk for consideration is the TBM equipment unable to mine the ground to the production needed to meet the schedule requirements (1-009-02).

Construction power is required for operation of the TBMs and associated equipment. The power is to be provided by Con Edison. A risk exists of a delay in obtaining the power from the utility (1-009-03).

CM012 GCT Caverns, Tunnel Lining, 63rd Street Tunnel Rehabilitation & Bellmouth Structure

Scope Assessment

The scope of this contract is to excavate and construct lining and interior concrete structures for the GCT caverns and station cross-passages and tail track tunnels and caverns; to construct concrete lining, interior concrete structures, and duct bench/maintenance walkways in the Manhattan tunnels; to rehabilitate the 63rd Street tunnel; and to excavate and concrete for escalator shafts, elevators, and ventilation/utility shafts. The scope is consistent with the FEIS.

Cost Assessment

The estimate for this contract is \$617,128,533. The PMOC reviewed the entire cost estimate and found the process for the formulation of the estimate to be sound – see page 14 Review of ESA Cost Estimating Methodology.

Schedule Assessment

PMOC reviewed the ESA's Integrated Project Schedule (IPS) for reasonableness of scope, time and risk. The IPS identifies major components of the project, including this contract. The contractor will prepare a detailed schedule based on the IPS which will define durations and inter-relationships. The IPS schedule represents a reasonable estimate of work tasks and inter-contract relationships.

Risk Assessment

Risks associated with this project include:

- Increased blasting restrictions
- Differing site conditions
- Poor waterproofing installation
- Excessive vibrations
- Insufficient concrete supply
- Mislocated benchwall.

This contract includes drill and blast excavation operations for the Grand Central Terminal (GCT) caverns and station cross-passages, tail-track tunnels, and escalator, elevator, and ventilation/utility shafts, all within close proximity to MNR facilities. The contract specifications will include MNR requirements regarding vibration levels. A risk exists that the blasting may induce vibration levels of concern to MNR, thus resulting in increased blasting restrictions by MNR (1-012-01).

The scope of this contract includes much excavation, most of it by drill and blast methods. A risk exists of a differing site condition where material encountered varies from what is known and expected, thus requiring modified excavation methods (1-012-02).

This contract constructs a concrete lining in the Manhattan tunnels and rehabilitates the 63rd Street tunnel, including leak repairs. Waterproofing is of utmost importance in underground construction. The nature and history of this type of work demonstrates that leakage may occur, especially at joints. A risk exists of poor waterproofing installation (1-012-03).

This contract performs much excavation by drill and blast methods. A risk exists that the blasting may induce excessive vibration levels which may result in the community shutting down the construction (1-012-04).

Much concrete work is performed on this contract. There is a possibility of an insufficient supply of concrete to meet the contractor's requirements. This is a risk that exists (1-012-05).

This contract constructs a duct bench/maintenance walkway within the Manhattan tunnels. A risk exists of a misalignment of the benchwall which could interfere with the train envelope (1-012-06).

CM013 38th, 50th & 55th Street Ventilation Facilities

Scope Assessment

The scope of this contract is to excavate and concrete vent plant structures at 38th and 55th Streets, and to perform building demolition, hazardous material abatement, utility relocations, structure underpinning and excavation and vertical shaft construction for a ventilation facility at 50th Street to be constructed under Contract CM014. The scope is consistent with the FEIS

Cost Assessment

The estimate for this contract is \$68,717,840. The PMOC reviewed the entire cost estimate and found the process for the formulation of the estimate to be sound – see page 14 Review of ESA Cost Estimating Methodology.

Schedule Assessment

PMOC reviewed the ESA's Integrated Project Schedule (IPS) for reasonableness of scope, time and risk. The IPS identifies major components of the project, including this contract. The contractor will prepare a detailed schedule based on the IPS which will define durations and inter-relationships. The IPS schedule represents a reasonable estimate of work tasks and inter-contract relationships.

Risk Assessment

Risks associated with this project include:

- DOT restricts use of streets for staging and hauling
- Court injunction preventing property taking
- Differing site condition
- Vibration/noise exceeds required limits
- Encountering unidentified utilities
- Late property acquisitions.

Ventilation facilities are constructed at 38th, 50th and 55th Streets. Open cut excavations at street level will be required. A risk exists that the NYCDOT may restrict the use of the streets for staging and hauling (1-013-01).

Real estate acquisition of properties and relocation of tenants are required at each ventilation facility. A risk exists of a court injunction preventing property taking (1-013-02).

Open cut excavation for the ventilating facilities are required. Geotechnical information is provided to the contractor. A risk exists of a differing site condition where material encountered and surrounding conditions may vary from what is known and expected (1-013-03).

Drilling and blasting methods of excavation will be performed at each site. This type of construction results in vibration and noise. A risk exists that the vibration and/or noise levels will exceed required limits (1-013-04)

Street level excavations will expose numerous utilities, which have been researched and the information given to the contractor. Utility relocations are included in this contract. A risk exists that unidentified utilities will be encountered (1-013-05).

Real estate acquisition of properties is required before this contract can begin. A risk exists of late property acquisition (1-013-06).

CM014 GCT Concourse and Cavern Finishes

Scope Assessment

The scope of this contract is to perform finish work in the GCT concourse and caverns, including the procurement, installation, testing and commissioning of escalators and elevators; and the construction of ventilation building structures at 44th Street and 50th Street. The scope is consistent with the FEIS.

Cost Assessment

The estimate for this contract is \$280,000,000. The PMOC reviewed the entire cost estimate and found the process for the formulation of the estimate to be sound – see page 14 Review of ESA Cost Estimating Methodology.

Schedule Assessment

PMOC reviewed the ESA's Integrated Project Schedule (IPS) for reasonableness of scope, time and risk. The IPS identifies major components of the project, including this contract. The contractor will prepare a detailed schedule based on the IPS which will define durations and inter-relationships. The IPS schedule represents a reasonable estimate of work tasks and inter-contract relationships.

Risk Assessment

Risks associated with this project include:

- Inadequate access to caverns
- Rail access from Queens
- MTA establishes unified Operations policy
- Unanticipated structural problems in GCT
- No MTA concurrence for 5 year escalator maintenance contract
- Inadequate access to concourse
- Lack of MNR outages
- DOT restrictions on staging/hauling
- Change in smoke exhaust duct requirements
- Contractor does not manage/control subcontractors
- Escalator manufacturing delays.

This contract performs the finishing work in the Grand Central Terminal (GCT) concourses and caverns. It is dependent on gaining access to the caverns through other construction projects and waiting on the completion of Contract CM012 before completing the finishing work. A risk exists of inadequate access to the caverns and a late completion of CM012, thus giving insufficient time for this contract to complete its work (1-014-01).

Some access to the work zones in the GCT concourses and caverns will be required by rail from Queens, through other construction projects. A risk exists of problems gaining this rail access (1-014-02).

Operations of MNR and LIRR need to be unified to prevent impacts to this contract. MTA needs to establish a unified ops policy through negotiations with MNR and LIRR. This is a risk that exists (1-014-03).

The finishing work of this contract includes work in the existing GCT structure. Unanticipated structural problems, especially relating to waterproofing, may be encountered with the GCT structure. This is a risk that exists (1-014-04).

The procurement and installation of escalators in GCT is included in this contract. A five year escalator maintenance contract with the manufacturer is expected. A risk exists that MTA concurrence will not transpire (1-014-05).

In addition to inadequate access to the caverns, a risk exists of inadequate access to the concourse work zones due to coordination problems with or late completion by other projects (1-014-06).

The work within the GCT will require track outages by the MNR as work is performed adjacent to existing tracks. A risk exists that MNR will not provide outages as required and planned by the contractor (1-014-07).

Open cut excavations at street level will be required under this contract. A risk exists that the NYCDOT may restrict the use of the streets for staging and hauling (1-014-08).

This project constructs ventilation building structures at 44th and 50th Streets. A risk exists of a change in smoke exhaust duct requirements (1-014-09).

The finishing work within the GCT will be performed by numerous subcontractors, each specialized in specific professions. Management and control of these subcontractors by the general contractor is of utmost importance. A risk exists that the contractor does not manage and control the subcontractors in an efficient manner (1-014-10).

Escalators in GCT will be procured under this contract. A risk exists of manufacturing delays (1-014-11).

CM015 GCT Surface Entrances

Scope Assessment

The scope of this contract is to construct GCT surface entrances at 44th Street, 45th Street, and 48th Street. It includes utility relocations, finish work, installation of escalators, and construction of manholes and conduit for ConEd services. The scope is consistent with the FEIS.

Cost Assessment

The estimate for this contract is \$44,738,451. The PMOC reviewed the entire cost estimate and found the process for the formulation of the estimate to be sound – see page 14 Review of ESA Cost Estimating Methodology.

Schedule Assessment

PMOC reviewed the ESA's Integrated Project Schedule (IPS) for reasonableness of scope, time and risk. The IPS identifies major components of the project, including this

contract. The contractor will prepare a detailed schedule based on the IPS which will define durations and inter-relationships. The IPS schedule represents a reasonable estimate of work tasks and inter-contract relationships.

Risk Assessment

Risks associated with this project include:

- Late real estate acquisition
- Encountering unexpected utilities
- Building owner opposition to property taking
- Unanticipated structural problems in primary structure
- Design approval by building owners
- DOT restrictions on staging/hauling.

This contract constructs GCT surface entrances at 44th, 45th and 48th Streets. Real estate acquisition is required. A risk exists of late acquisition of the properties (1-015-01).

Street level excavations will expose numerous utilities. Utility locations have been researched and the information will be given to the contractor. Utility relocations are included in this contract. A risk exists that unidentified utilities will be encountered (1-015-02).

Real estate acquisition is required for this contract. A risk exists that the property owner at 48th Street will oppose the taking of his property (1-015-03).

Much of the surface entrance work will be interfaced with the existing GCT. A risk exists of encountering unanticipated structural problems of the existing GCT structure during exposure of structural elements (1-015-04).

Design of the GCT surface entrances will require approval from building owners and others. Acquiring this approval is a risk that exists (1-015-05).

Open cut excavations at street level will be required under this contract. A risk exists that the NYCDOT may restrict the use of the streets for staging and hauling (1-015-06).

CM016 Manhattan Approach Tunnels Excavation by Road Header

Scope Assessment

The scope of this contract was to lease an ATM 105 Road-Header, or equal, and then use the equipment to excavate approach tunnels (333 LF) to the Manhattan tunnels. It includes removing the existing bulkhead at the Queens Bellmouth and installation of utilities and instrumentation of existing NYCT tunnels and building structures in the vicinity of the excavation. The scope is consistent with the FEIS.

Cost Assessment

The contract was terminated due to low productivity rate and is in closeout.

Schedule Assessment

This contract is in close-out.

Risk Assessment

This contract is in close-out.

CM017 GCT East Yard – Environmental Remediation

Scope Assessment

The scope of this contract is the abatement of hazardous materials within the GCT lower level East Yard area. The scope is consistent with the FEIS.

Cost Assessment

This contract is substantially complete.

Schedule Assessment

This contract is substantially complete.

Risk Assessment

This contract is substantially complete.

CMS16 63rd Street Tunnel Abatement

Scope Assessment

The scope of this contract was the abatement of asbestos containing materials in the existing 63rd Street tunnel. The scope is consistent with the FEIS.

Risk Assessment

This project has achieved substantial completion.

Cost Assessment

This project has reached substantial completion.

Schedule Assessment

This project has achieved substantial completion.

QUEENS THIRD PARTY CONTRACTS

CQ 025 Demolish Superior Reed Building and Existing Rail Yard

Scope Assessment

The scope of this contract is to perform hazardous material abatement and demolish two structures of the Superior Reed building and to perform environmental remediation of ballast/surface soils and remove tracks, signals, and utilities in the existing rail yard; and to construct NYAR re-route track. The scope is consistent with the FEIS.

Cost Assessment

This contract is substantially complete.

Schedule Assessment

This contract is substantially complete.

Risk Assessment

This contract is substantially complete.

CQ 026 Queens Open-Cut Excavation at the Existing Bellmouth

Scope Assessment

The scope of this contract is to construct a noise barrier wall, perimeter slurry wall, sheet pile walls and soil excavation and support the open-cut structure from the existing Bellmouth to the west side of Northern Boulevard. It includes demolishing the existing slurry wall at the Bellmouth structure and excavating rock to one foot below top of invert elevation. The scope is consistent with the FEIS.

Cost Assessment

This project has achieved substantial completion.

Schedule Assessment

This project has achieved substantial completion.

Risk Assessment

This project has achieved substantial completion.

CQ 027 Arch Street Yard and Shop Facility

Scope Assessment

The scope of this contract is to perform work in the Arch Street Yard, including environmental mitigation; drainage systems; utility relocations; yard track and traction power systems; connecting tracks to the existing rail yard; and constructing maintenance of equipment shop, yard power sub-station, EIC platform and storage building,

engineering support building, and a hazardous waste storage structure. The scope is consistent with the FEIS.

Cost Assessment

The firm price bid for this contract is \$75,175,000. The ESA estimate for this contract has been confirmed by the bid process and the cost is within the budget amount.

Schedule Assessment

PMOC reviewed the ESA's Integrated Project Schedule (IPS) for reasonableness of scope, time and risk. The IPS identifies major components of the project, including this contract. The contractor prepared a detailed schedule based on the IPS which identified durations and inter-relationships. Substantial Completion originally planned for June 28, 2004, was delayed to December 29, 2004 due to redesign of track, and a change to the car hoist design.

Risk Assessment

This contract is nearing substantial completion.

CQ 028 Queens Open-Cut Excavation and Tunnel under Northern Boulevard

Scope Assessment

The scope of this contract is to perform environmental remediation; construct slurry walls and perform soil and rock excavation for open-cut tunnels south of Northern Boulevard to the rail yard; and to underpin the elevated and subway structures and excavate and construct the tunnel under Northern Boulevard. The scope is consistent with the FEIS.

Cost Assessment

The firm price bid for this contract is \$95,890,877. The ESA estimate for this contract has been confirmed by the bid process and the cost is within the budget amount.

Schedule Assessment

PMOC reviewed the ESA's Integrated Project Schedule (IPS) for reasonableness of scope, time and risk. The IPS identifies major components of the project, including this contract. The contractor will prepare a detailed schedule based on the IPS which will define durations and inter-relationships. The IPS schedule represents a reasonable estimate of work tasks and inter-contract relationships.

Risk Assessment

Risks associated with this work include:

- Geotechnical differing site condition encountered
- Archaeological find
- Excessive heave / settlement of elevated and subway structures

- Long Island well permit delay

This contract is open-cut excavation in Queens from south of Northern Blvd. to the rail yards. Geotechnical information is provided to the contractor. A risk exists of a differing site condition where conditions encountered vary from what is known and expected (2-028-01).

During excavation, there is a possibility of an archaeological find which would require a study and documentation. This is a risk that exists (2-028-02).

This contract excavates under Northern Blvd. for construction of a tunnel. It requires underpinning of existing elevated and subway structures. A risk exists of excessive heave and / or settlement of these structures during excavation operations (2-028-03).

A Long Island well permit is required for this contract. A risk exists of a delay in executing the permit (2-028-04).

CQ 031 Queens Bored-Tunnels and Structures

Scope Assessment

The scope of this contract includes the procurement of two tunnel boring machines (TBM) and then the assembly and use of the equipment to excavate the tunnels in Queens; installing pre-cast concrete tunnel liner; constructing concrete invert slab and benchwalls in lined tunnels; underpinning bridge piers; construction a track-bridge over TBM launch area; demolishing buildings at 43rd Street; construction emergency exits; and construction interior walls, equipment rooms, stair access-ways, and reception pits roofs for Track A, Track D, and Yard Lead. The scope is consistent with the FEIS.

Cost Assessment

The estimate for this contract is \$270,145,041. The PMOC reviewed the entire cost estimate and found the process for the formulation of the estimate to be sound – see page14 Review of ESA Cost Estimating Methodology.

Schedule Assessment

PMOC reviewed the ESA's Integrated Project Schedule (IPS) for reasonableness of scope, time and risk. The IPS identifies major components of the project, including this contract. The contractor will prepare a detailed schedule based on the IPS which will define durations and inter-relationships. The IPS schedule represents a reasonable estimate of work tasks and inter-contract relationships.

Risk Assessment

Risks associated with this contract include:

- Geotechnical differing site condition encountered
- Tunnel off line / grade

- TBM unable to mine ground to meet schedule
- Excessive leakage through segments
- Late completion of CQ028

This contract is tunnel excavation in Queens by Tunnel Boring Machine (TBM) equipment. Soft-ground tunneling is expected. Geotechnical information is provided to the contractor. A risk exists of a differing site condition where material encountered varies from what is known and expected (2-031-01).

Tunneling in Queens will be through varying rock and soil formations, including the possibility of encountering boulders. These varying conditions could result in tunnel boring problems with a consequence of the tunnel being off line or grade. This is a risk that exists (2-031-02).

The schedule for this contract will determine a production rate of tunneling operations in order to complete the project on time. A risk for consideration is the TBM equipment unable to mine the ground to the production rate needed to meet the schedule requirements (2-031-03).

This contract installs pre-cast concrete tunnel liners for the tunnel construction in Queens. There is a possibility of leakage through the joints of the pre-cast segments. This is a risk that exists (2-031-04).

The tunneling operations in Queens start after completion of Contract CQ028, the Queens open cut excavation project. A risk exists of a late completion of CQ028 (2-031-05).

CQ 032 Tunnel Structure at Existing Rail Yard

Scope Assessment

The scope of this contract is to complete tunnel construction within cut-cover excavation by others and complete ventilation and air intake/exhaust structures, including waterproofing and backfilling. In addition, it includes constructing a facility for Yard Services Building and constructing and maintaining a groundwater treatment system. The scope is consistent with the FEIS.

Cost Assessment

The estimate for this contract is \$78,528,366. The PMOC reviewed the entire cost estimate and found the process for the formulation of the estimate to be sound – see page 14 Review of ESA Cost Estimating Methodology.

Schedule Assessment

PMOC reviewed the ESA's Integrated Project Schedule (IPS) for reasonableness of scope, time and risk. The IPS identifies major components of the project, including this contract. The contractor will prepare a detailed schedule based on the IPS which will

define durations and inter-relationships. The IPS schedule represents a reasonable estimate of work tasks and inter-contract relationships.

Risk Assessment

Risks associated with this contract are included under project-wide risks.

CQ 033 Mid-Day Storage Yard Facility

Scope Assessment

The scope of this contract relates to work in the mid-day storage yard. The work includes building demolition; environmental remediation; grading; procuring and installing ballast, ties, track and third rail; constructing LIRR car wash facility; installing mechanical and electrical equipment for yard facilities; installing, testing and commissioning yard signals and traction power systems; and configuring Amtrak, NYAR and LIRR tracks to final configuration. The scope is consistent with the FEIS.

Cost Assessment

The estimate for this contract is \$124,514,026. The PMOC reviewed the entire cost estimate and found the process for the formulation of the estimate to be sound – see page14 Review of ESA Cost Estimating Methodology.

Schedule Assessment

PMOC reviewed the ESA's Integrated Project Schedule (IPS) for reasonableness of scope, time and risk. The IPS identifies major components of the project, including this contract. The contractor will prepare a detailed schedule based on the IPS which will define durations and inter-relationships. The IPS schedule represents a reasonable estimate of work tasks and inter-contract relationships.

Risk Assessment

Risks associated with this contract are listed under project-wide risks.

CQ 034 Sunnyside Passenger Station

Scope Assessment

The scope of this contract is construction of a new Sunnyside Passenger Station. It includes constructing platforms, headhouse, architectural finishes, mechanical and electrical equipment, and vertical circulation. Also included is underpinning and relocating piers and/or columns and construction bridge parapet and barriers on the Queens Boulevard Bridge. The scope is consistent with the FEIS.

Cost Assessment

The estimate for this contract is \$24,029,838. The PMOC reviewed the entire cost estimate and found the process for the formulation of the estimate to be sound – see page14 Review of ESA Cost Estimating Methodology.

Schedule Assessment

PMOC reviewed the ESA's Integrated Project Schedule (IPS) for reasonableness of scope, time and risk. The IPS identifies major components of the project, including this contract. The contractor will prepare a detailed schedule based on the IPS which will define durations and inter-relationships. The IPS schedule represents a reasonable estimate of work tasks and inter-contract relationships.

Risk Assessment

Risks associated with this work include:

- Excessive settlement of bridge piers
- Lack of easements/acquisitions
- Third party contractor affects/impacts RR operations
- Lack of track outages – LIRR
- Lack of track outages – Amtrak

CQ 040 Amtrak Buildings Demolition and Relocation

Scope Assessment

The scope of this contract is to replace and relocate Amtrak Buildings 3 and 4 and demolish existing Amtrak Buildings 3 and 4. It includes relocation of utilities. The scope is consistent with the FEIS.

Cost Assessment

The estimate for this contract is \$17,694,749. The PMOC reviewed the entire cost estimate and found the process for the formulation of the estimate to be sound – see page 14 Review of ESA Cost Estimating Methodology.

Schedule Assessment

PMOC reviewed the ESA's Integrated Project Schedule (IPS) for reasonableness of scope, time and risk. The IPS identifies major components of the project, including this contract. The contractor will prepare a detailed schedule based on the IPS which will define durations and inter-relationships. The IPS schedule represents a reasonable estimate of work tasks and inter-contract relationships.

Risk Assessment

Risks associated with this work include:

- Lack of Amtrak agreement for access and design development
- Lack of easements/acquisitions
- Lack of track outages – Amtrak
- Inability to relocate then demolish Amtrak Buildings 3 and 4

VQ064 Q Interlocking CIL

VQ065 Loop Interlocking CIL

Scope Assessment

The scope for these contracts is to design, manufacture, test and deliver Q Interlocking CIL and Loop CILs and to provide vendor support during direct force account installations. The scope is consistent with the FEIS.

Cost Assessment

The PMOC reviewed the entire cost estimate and found the process for the formulation of the estimate to be sound – see page14 Review of ESA Cost Estimating Methodology.

Schedule Assessment

PMOC reviewed the ESA's Integrated Project Schedule (IPS) for reasonableness of scope, time and risk. The IPS identifies major components of the project, including these contracts. The contractor will prepare a detailed schedule based on the IPS which will define durations and inter-relationships. The IPS schedule represents a reasonable estimate of work tasks and inter-contract relationships.

Risk Assessment

Risks associated with this work include:

- Signal vendor not having capacity to perform the work

HAROLD THIRD PARTY CONTRACTS

CH053 Harold Structures – Part 1

CH054 Harold Structures – Part 2

CH059 Harold Structures – Part 3

VH051 Harold and Point CIL

CH060 Cross-Connector

VH052 F Interlocking CIL

VH055 Procure Switch and Panel Exchange System (SES)

Scope Assessment

The scope of "CH" contracts consists primarily of demolition of buildings and bridges and construction of structures and track realignments within the Harold Interlocking portion of the project. The scope is consistent with the construction areas indicated in the FEIS as well as with the Real Estate Acquisition Plan.

The scope of “VH” contracts includes the design, manufacture, test, and delivery of CIL’s (Central Instrument Locations) and the procurement of a 17 car SES. The scope is consistent with the FEIS.

Cost Assessment

The PMOC reviewed the entire cost estimate and found the process for the formulation of the estimate to be sound – see page 14 Review of ESA Cost Estimating Methodology.

Schedule Assessment

The PMOC reviewed the ESA’s Integrated Project Schedule (IPS) for these contracts for reasonableness of scope, time and risk. The IPS identifies major components of the project, including these contracts. The contractor will prepare a detailed schedule based on the IPS, which will define durations and inter-relationships. The IPS schedule represents a reasonable estimate of work tasks and inter-contract relationships.

Risk Assessment

Risks associated with this work include:

- Lack of track outages – LIRR
- Encountering unknown environmental issues
- Lack of track outages - AMTRAK
- Third party contractor impacts LIRR operations
- Signal vendor not having capacity to perform
- Delay in material procurement
- Lack of Amtrak agreement /resources
- Encountering unanticipated utilities
- Geotechnical differing site condition encountered
- Lack of LIRR resources
- Delay in stage completion by third party contractor
- Change in alignment
- Delay in AMTRAK design approvals
- Change in alignment due to AMTRAK

Work within the Harold Interlocking area requires track outages by LIRR as work is performed adjacent to existing tracks. A risk exists that LIRR will not provide outages as required and planned by the contractor (3-000-01).

Work within the Harold Interlocking and Sunnyside Yard areas will be in the vicinity of plumes of hazardous material. An Amtrak agreement has been executed with MTA with

the understanding that MTA has obtained insurance coverage to cover the cost of unknown environmental issues. The coverage protects Amtrak, hence the agreement. A risk exists that an unknown environmental issue will be encountered (3-000-02).

Work within the Harold Interlocking area requires track outages by AMTRAK as work is performed adjacent to existing tracks. A risk exists that AMTRAK will not provide outages as required and planned by the contractor (3-000-03).

Tunneling construction within the Harold Interlocking and Sunnyside Yard areas could cause settlement of the operating tracks, thus affecting/impacting railroad operations. This is a risk that exists (3-000-04).

At the present time, only two signal vendors are qualified for this project. Past history indicates delays are possible due to the signal vendor not having the capacity to perform. This is a risk that exists (3-000-05).

Material procurement for the Harold Interlocking and Sunnyside Yard areas is very important, especially for switches. A risk exists of a delay of material procurement (3-000-06).

Work within the Harold Interlocking and Sunnyside Yard areas will require much coordinated work by Amtrak in support of the general contractor. A risk exists of a delay in executing an AMTRAK agreement and / or a lack of Amtrak resources to support the contractor's schedule (3-000-07).

As-built locations of railroad utilities are not well documented. It is possible that unanticipated utilities will be encountered during excavation operations. This is a risk that exists (3-000-08).

Tunneling and excavation operations are performed in the Harold Interlocking and Sunnyside Yard areas. Geotechnical information is provided to the contractor. A risk exists of a differing site condition where material encountered, especially with the prospect of encountering boulders, varies from what is known and expected (3-000-09).

Work within the Harold Interlocking and Sunnyside Yard areas will require much coordinated work by LIRR in support of the general contractor, especially related to signal workers (conductors). A risk exists of a lack of LIRR resources to support the contractor's schedule (3-000-10).

Work in the Harold Interlocking area has been carefully planned into numerous stages in order to maintain railroad operations and lessen interferences. A risk exists of a delay in stage completion by a third-party contractor (3-000-11).

Due to existing geotechnical conditions and possibly encountering unknown building foundations, track alignment may need to be revised. This is a risk that exists (3-000-12).

Design of work within the Harold Interlocking area will require approval by Amtrak. The standard for Amtrak to turnaround design reviews is 45 days. A risk exists of a lack of Amtrak resources and a delay in approving designs (3-000-13).

Track alignment, including the location of switches, requires approval by Amtrak. A risk exists of Amtrak requiring a change in alignment (3-000-14).

PROJECT-WIDE THIRD PARTY CONTRACTS

CS078 Track & Third-Rail on Direct Fixation

Scope Assessment

The scope for this contract is to procure and install special trackwork, running rail and third-rail for the full length of the ESA tunnels, including construction of reinforced concrete plinths with embedded inserts to support the track and special trackwork units. This contract does not include the procurement of direct fixation fasteners, which is Contract VS077. The scope is consistent with the FEIS.

Cost Assessment

The estimate for this contract is \$61,732,477. The PMOC reviewed the entire cost estimate and found the process for the formulation of the estimate to be sound – see page14 Review of ESA Cost Estimating Methodology.

Schedule Assessment

PMOC reviewed the ESA's Integrated Project Schedule (IPS) for reasonableness of scope, time and risk. The IPS identifies major components of the project, including this contract. The contractor will prepare a detailed schedule based on the IPS which will define durations and inter-relationships. The IPS schedule represents a reasonable estimate of work tasks and inter-contract relationships.

Risk Assessment

Risks associated with this work include:

- Inadequate coordination of trackwork and systems
- Track realignment design delay to fit as-built conditions

This contract installs trackwork and third-rail for the full length of the ESA tunnels. It will be under construction at the same time as Contract CS079, the project that installs power, signals, communications and other system elements. Coordination between contracts is of utmost importance. A risk exists of inadequate coordination (4-078-01).

The installation of track and third-rail is dependent on the preceding tunneling construction. A misalignment of the tunnels could result in a redesign of the trackwork. A risk exists of a track realignment design delay to fit as-built conditions of any misalignments (4-078-02).

CS079 Power, Signals, Communications & Other System Elements

Scope Assessment

The scope for this contract is to procure, fabricate, install, test and commission equipment and material for the following systems:

- Traction Power Systems
- Facilities Power Systems
- Queens Bulk Power System
- Tunnel Lighting,, Emergency Power & Signal Power System
- Signaling System
- Communications and SCADA
- GCT Train Operations Center (TOC)
- GCT Terminal Management Center (TMC)
- ESA Operations Control Center (OCC)
- Fire Protection
- Fire Alarm System
- Security System
- Integrated Systems.

The scope is consistent with the FEIS.

Cost Assessment

The estimate for this contact is \$306,825,539. The PMOC reviewed the entire cost estimate and found the process for the formulation of the estimate to be sound – see page14 Review of ESA Cost Estimating Methodology.

Schedule Assessment

PMOC reviewed the ESA's Integrated Project Schedule (IPS) for reasonableness of scope, time and risk. The IPS identifies major components of the project, including this contract. The contractor will prepare a detailed schedule based on the IPS which will define durations and inter-relationships. The IPS schedule represents a reasonable estimate of work tasks and inter-contract relationships.

Risk Assessment

Risks associated with this work include:

- Delay in completing systems works
- RR increases requirements for systems elements

- Delay by ConEd providing permanent feeders
- Integration of software/hardware
- Lack of competition.

There is much work to be performed under this contract with access reliance with the structural contracts. Coordination with numerous other contracts is very important in order to keep this CS079 contract moving ahead on schedule. A risk exists of a delay in completing the systems work (4-079-01).

Construction of this contract is scheduled from 2008 through 2012. Between now and then, new technology could develop for the control systems which the railroads may require be incorporated into this contract. A risk exists that the railroads will increase their requirements for systems elements (4-079-02).

This contract requires ConEdison to provide permanent feeders. A risk exists of a delay by ConEdison in providing the feeders (4-079-03).

This contract procures, fabricates and installs ESA Operations Control Center (OCC) hardware. LIRR will furnish the OCC software. A risk exists of an integration problem between the hardware and software (4-079-04).

This contract procures, fabricates, installs and tests systems elements, including traction power, signals, communications, lighting and security systems. With all of the systems work lumped into one contract, there is the possibility that lack of competition will produce a risk (4-079-05).

CS081 Tunnel Ventilation Systems

Scope Assessment

The scope for this contract is to provide and install structural steel for vent structures and to procure, fabricate, deliver, install, balance and test ventilation equipment for all ventilation facilities throughout the project. The scope is consistent with the FEIS.

Cost Assessment

The estimate for this contract is \$92,996,648. The PMOC reviewed the entire cost estimate and found the process for the formulation of the estimate to be sound – see page 14 Review of ESA Cost Estimating Methodology.

Schedule Assessment

PMOC reviewed the ESA's Integrated Project Schedule (IPS) for reasonableness of scope, time and risk. The IPS identifies major components of the project, including this contract. The contractor will prepare a detailed schedule based on the IPS which will define durations and inter-relationships. The IPS schedule represents a reasonable estimate of work tasks and inter-contract relationships.

Risk Assessment

Risks associated with this work include:

- Late access for system-wide vent testing/commissioning
- Lack of power for vent plant testing/commissioning
- Change in NFPA 130 and other operating criteria requirements.

This contract tests and commissions the tunnel ventilation systems. System-wide testing requires access to the full length of the ESA tunnels. A risk exists of late access to perform the testing (4-081-01).

Power is required for the ventilation system testing. Contract CS079 procures and installs the equipment and material for this power. A lack of power in order to perform the testing is a risk that exists (4-081-02).

Operating criteria of the ventilation system is specified. A risk exists of a change in the NFPA 130 and other operating criteria (4-081-03).

VS077 Procure Direct Fixation Rail Fasteners

Scope Assessment

The scope for this contract is to procure direct fixation fasteners for installation by others for the full length of the ESA tunnels. The scope is consistent with the FEIS.

Cost Assessment

The estimate for this contract is \$7,655,776. The PMOC reviewed the entire cost estimate and found the process for the formulation of the estimate to be sound – see page14 Review of ESA Cost Estimating Methodology.

Schedule Assessment

PMOC reviewed the ESA's Integrated Project Schedule (IPS) for reasonableness of scope, time and risk. The IPS identifies major components of the project, including this contract. The contractor will prepare a detailed schedule based on the IPS which will define durations and inter-relationships. The IPS schedule represents a reasonable estimate of work tasks and inter-contract relationships.

Risk Assessment

Risks associated with this work include:

- Competing projects
- Delay in obtaining track fasteners

HAROLD FORCE ACCOUNT CONTRACTS

FHA01	Harold Stage 1 - Amtrak F/A
FHA02	Harold Stage 2 - Amtrak F/A
FHA03	Harold Stage 3 – Amtrak F/A
FHA04	Harold Stage 4 – Amtrak F/A
FHA53	Harold Structures (Part 1) – Amtrak F/A
FHA54	Harold Structures (Part 2) – Amtrak F/A
FHA59	Harold Structures (Part 3) – Amtrak F/A
FHA60	Cross Connector – Amtrak F/A
FHL01	Harold Stage 1 – LIRR F/A
FHL02	Harold Stage 2 – LIRR F/A
FHL03	Harold Stage 3 – LIRR F/A
FHL04	Harold Stage 4 – LIRR F/A
FHL53	Harold Structures (Part 1) – LIRR F/A
FHL54	Harold Structures (Part 2) – LIRR F/A
FHL59	Harold Structures (Part 3) – LIRR F/A
FHL60	Cross Connector – LIRR F/A

Scope Assessment

The scope of these contracts calls for Amtrak and LIRR to provide force account resources for various railroad construction installations and cut-overs (such as catenary, trackwork, third-rail, cable and signals) and to provide flag protection for contractor employees working within the fouling limits of train operations, all within the Harold Interlocking portion of the project. The scope is consistent with the FEIS.

Cost Assessment

The PMOC reviewed the entire cost estimate and found the process for the formulation of the estimate to be sound – see page 14 Review of ESA Cost Estimating Methodology.

Schedule Assessment

PMOC reviewed the ESA's Integrated Project Schedule (IPS) for reasonableness of scope, time and risk. The IPS identifies major components of the project, including these

contracts. The contractor will prepare a detailed schedule based on the IPS which will define durations and inter-relationships. The IPS schedule represents a reasonable estimate of work tasks and inter-contract relationships.

Risk Assessment

Risks associated with this work include:

- Lack of Amtrak & LIRR resources
- Delay in stage completion by third party contractor
- Delay in material procurement.

VHA01	Procure Materials for Harold Stage 1 – Amtrak
VHA02	Procure Materials for Harold Stage 2 – Amtrak
VHA03	Procure Materials for Harold Stage 3 – Amtrak
VHA04	Procure Materials for Harold Stage 4 – Amtrak
VHL01	Procure Materials for Harold Stage 1 – LIRR
VHL02	Procure Materials for Harold Stage 2 – LIRR
VHL03	Procure Materials for Harold Stage 3 – LIRR
VHL04	Procure Materials for Harold Stage 4 – LIRR

Scope Assessment

The scope of these contracts requires Amtrak and LIRR to procure material for railroad force account construction by Amtrak and LIRR related to trackwork, third-rail and power, signals, communications and catenary work within the Harold Interlocking portion of the project. The scope is consistent with the FEIS.

Cost Assessment

The PMOC reviewed the entire cost estimate and found the process for the formulation of the estimate to be sound – see page14 Review of ESA Cost Estimating Methodology.

Schedule Assessment

PMOC reviewed the ESA’s Integrated Project Schedule (IPS) for reasonableness of scope, time and risk. The IPS identifies major components of the project, including these contracts. The contractor will prepare a detailed schedule based on the IPS which will define durations and inter-relationships. The IPS schedule represents a reasonable estimate of work tasks and inter-contract relationships.

Risk Assessment

Risks associated with this work include:

- Delay in material procurement

MANHATTAN FORCE ACCOUNT CONTRACTS

FMM01 Replacement Yard at Highbridge – MNR F/A

FMM15 GCT Surface Entrances – MNR F/A

FMM17 GCT East Yard Environmental Remediation – MNR F/A

Scope Assessment

The scope for these contracts provides for Metro-North Railroad to provide force account resources to support the CM001 contractor constructing replacement facilities at Highbridge; to inspect, test and accept completed GCT surface entrance facilities by the CM015 contractor; and to support the CM017 contractor doing GCT East Yard environmental remediation work. The scope is consistent with the FEIS.

Cost Assessment

The PMOC reviewed the entire cost estimate and found the process for the formulation of the estimate to be sound – see page 14 Review of ESA Cost Estimating Methodology.

Schedule Assessment

PMOC reviewed the ESA's Integrated Project Schedule (IPS) for reasonableness of scope, time and risk. The IPS identifies major components of the project, including these contracts. The contractor will prepare a detailed schedule based on the IPS which will define durations and inter-relationships. The IPS schedule represents a reasonable estimate of work tasks and inter-contract relationships.

Risk Assessment

Risks associated with this work include:

- Lack of MNR F/A for direct work
- Delay in stage completion by third party contractor
- Lack of MNR resources

Note: Projects FMM01 and FMM17 have achieved substantial completion

FMM02 GCT East Yard Track & Systems Modifications – MNR F/A Agreement

Scope Assessment

The scope for this contract is for Metro-North Railroad to provide force account resources for GCT East Yard track and systems modifications. The work includes procuring and installing track systems; installing/replacing communication and signal systems; installing/replacing traction power apparatus; and installing yard lighting. All work is performed by MNR. The scope is consistent with the FEIS.

Cost Assessment

The PMOC reviewed the entire cost estimate and found the process for the formulation of the estimate to be sound – see page 14 Review of ESA Cost Estimating Methodology.

Schedule Assessment

PMOC reviewed the ESA's Integrated Project Schedule (IPS) for reasonableness of scope, time and risk. The IPS identifies major components of the project, including this contract. The contractor will prepare a detailed schedule based on the IPS which will define durations and inter-relationships. The IPS schedule represents a reasonable estimate of work tasks and inter-contract relationships.

Risk Assessment

Risks associated with this work include:

- Lack of MNR F/A for direct work
- Lack of MNR resources

FMM09 Manhattan Tunnels Excavation – MNR F/A

FMM12 GCT Caverns, Tunnel Lining, 63rd Street Tunnel Rehabilitation & Bellmouth Closure – MNR F/A

FMM13 38th, 50th & 55th Street Vent Plant Facilities – MNR F/A

FMM14 GCT Concourse & Caverns Finishes – MNR F/A

Scope Assessment

The scope of these contracts is for Metro-North Railroad to provide force account resources to support third-party contracts, including monitoring of MNR facilities, track installation at the BN yard site, and to transport materials and equipment by work trains. The scope is consistent with the FEIS.

Cost Assessment

The PMOC reviewed the entire cost estimate and found the process for the formulation of the estimate to be sound – see page 14 Review of ESA Cost Estimating Methodology.

Schedule Assessment

PMOC reviewed the ESA's Integrated Project Schedule (IPS) for reasonableness of scope, time and risk. The IPS identifies major components of the project, including these contracts. The contractor will prepare a detailed schedule based on the IPS which will define durations and inter-relationships. The IPS schedule represents a reasonable estimate of work tasks and inter-contract relationships.

Risk Assessment

Risks associated with this work include:

- Lack of MNR F/A for direct work
- Failure by MNR to acquire locomotive for MNR work trains
- Delay in stage completion by third party contractor
- Lack of MNR resources

FML12 GCT Caverns, Tunnel Lining, 63rd Street Tunnel Rehabilitation & Bellmouth Closure – LIRR F/A

FML14 GCT Concourse & Caverns Finishes – LIRR F/A

FML 15 GCT Surface Entrances – LIRR F/A

Scope Assessment

The scope of these contracts is for LIRR to provide force account resources to support third-party contracts. The work includes inspection, testing and acceptance of completed facilities. The scope is consistent with the FEIS

Cost Assessment

The PMOC reviewed the entire cost estimate and found the process for the formulation of the estimate to be sound – see page14 Review of ESA Cost Estimating Methodology.

Schedule Assessment

PMOC reviewed the ESA's Integrated Project Schedule (IPS) for reasonableness of scope, time and risk. The IPS identifies major components of the project, including these contracts. The contractor will prepare a detailed schedule based on the IPS which will define durations and inter-relationships. The IPS schedule represents a reasonable estimate of work tasks and inter-contract relationships.

Risk Assessment

Risks associated with this work include:

- Lack of LIRR resources
- Delay in stage completion by third party contractor

FMM04 245 Park Avenue Entrance – MNR F/A

Scope Assessment

The scope for this contract is for Metro-North Railroad to provide force account resources to support the CM004 contractor during construction of the 245 Park Avenue entrance. The work to be performed by MNR includes providing a work train to transport materials and demolition debris; relocating MNR utilities; removing existing rail and third rail; and relocating a signal case. The work is consistent with the FEIS.

Cost Assessment

The PMOC reviewed the entire cost estimate and found the process for the formulation of the estimate to be sound – see page 14 Review of ESA Cost Estimating Methodology.

Schedule Assessment

PMOC reviewed the ESA's Integrated Project Schedule (IPS) for reasonableness of scope, time and risk. The IPS identifies major components of the project, including this contract. The contractor will prepare a detailed schedule based on the IPS which will define durations and inter-relationships. The IPS schedule represents a reasonable estimate of work tasks and inter-contract relationships.

Risk Assessment

Risks associated with this work include:

- Lack of MNR F/A for direct work
- Lack of MNR resources
- Failure by MNR to acquire locomotive for MNR work trains
- Delay in stage completion by third party contractor

FMM08 GCT Concourse Civil & Structural – MNR F/A

Scope Assessment

The scope for this contract is for Metro-North Railroad to provide force account resources to support the CM008 contractor for GCT concourse Civil and Structural construction. The work to be performed by MNR includes providing a work train to transport materials and demolition debris; relocating MNR utilities and GCT utilities and steam lines; removing existing rail, third rail and abandoned signals; constructing temporary track and signals; modifying GCT upper level platforms; and procuring and maintaining locomotives for MNR work trains. The scope is consistent with the FEIS.

Cost Assessment

The PMOC reviewed the entire cost estimate and found the process for the formulation of the estimate to be sound – see page 14 Review of ESA Cost Estimating Methodology.

Schedule Assessment

PMOC reviewed the ESA's Integrated Project Schedule (IPS) for reasonableness of scope, time and risk. The IPS identifies major components of the project, including this contract. The contractor will prepare a detailed schedule based on the IPS which will define durations and inter-relationships. The IPS schedule represents a reasonable estimate of work tasks and inter-contract relationships.

Risk Assessment

Risks associated with this work include:

- Lack of MNR F/A for direct work
- Lack of MNR resources
- Encountering unexpected utilities
- Delay in stage completion by third party contractor

FMT09	Manhattan Tunnels Excavation – NYCT F/A
FMT12	GCT Caverns, Tunnel Lining, 63rd Street Tunnel Rehabilitation & Bellmouth Closure – NYCT F/A
FMT13	38th, 50th & 55th Street Vent Plant Facilities – NYCT F/A
FMT16	Manhattan Approach Tunnels Excavation by Road Header – NYCT F/A

Scope Assessment

The scope for these contracts is for NYCT to provide force account resources to support the CM009, CM012, CM013 and CM016 contractors during construction. The work consists of monitoring NYCT facilities and providing inspection of construction activities for the 38th, 50th and 55th Street vent plant facilities. The scope is consistent with the FEIS.

Cost Assessment

The PMOC reviewed the entire cost estimate and found the process for the formulation of the estimate to be sound – see page 14 Review of ESA Cost Estimating Methodology.

Schedule Assessment

PMOC reviewed the ESA's Integrated Project Schedule (IPS) for reasonableness of scope, time and risk. The IPS identifies major components of the project, including these contracts. The contractor will prepare a detailed schedule based on the IPS which will define durations and inter-relationships. The IPS schedule represents a reasonable estimate of work tasks and inter-contract relationships.

Risk Assessment

Risks associated with this work include:

- Lack of NYCT resources
- Delay in stage completion by third party contractor

FMT19 Lexington Avenue IRT Improvements – NYCT F/A

Scope Assessment

The scope for this contract is to re-configure the NYCT's Lexington Avenue subway station at GCT to accommodate the increased passenger flow resulting from the ESA project. It includes demolition; removal of existing columns and beams; structural steel and concrete construction; new stairways; and mechanical, electrical and architectural finishes. The scope is consistent with the FEIS.

Cost Assessment

The PMOC reviewed the entire cost estimate and found the process for the formulation of the estimate to be sound – see page 14 Review of ESA Cost Estimating Methodology.

Schedule Assessment

PMOC reviewed the ESA's Integrated Project Schedule (IPS) for reasonableness of scope, time and risk. The IPS identifies major components of the project, including this contract. The contractor will prepare a detailed schedule based on the IPS which will define durations and inter-relationships. The IPS schedule represents a reasonable estimate of work tasks and inter-contract relationships.

Risk Assessment

Risks associated with this work include:

- Steel price increase
- Concrete price increase
- Job shut down due to security concerns
- Lack of MNR resources for work train transportation
- Lack of NYCT resources

QUEENS FORCE ACCOUNT CONTRACTS

FQA25 Demolish Superior Reed & Existing Rail Yard – Amtrak F/A

FQN25 Demolish Superior Reed & Existing Rail Yard – NYAR F/A

FQT25 Demolish Superior Reed & Existing Rail Yard – NYCT F/A

Scope Assessment

The scope for these contracts is for Amtrak, NYAR and NYCT to provide force account resources to support the CQ25 contractor. The support is to provide flag protection for contractor employees working within the fouling limits of train operations. The scope is consistent with the FEIS.

Cost Assessment

These contracts are substantially complete.

Schedule Assessment

These contracts are substantially complete.

Risk Assessment

These contracts are substantially complete.

FQT26 Queens Open-Cut Excavation at the Existing Bellmouth – NYCT F/A

Scope Assessment

The scope for this contract is for NYCT to provide force account resources for flag protection for the Contract CQ 026 contractor employees working within the fouling limits of train operations and also to monitor NYCT facilities during drill and blast, sheet piles and slurry wall operations. The scope is consistent with the FEIS.

Cost Assessment

This contract is substantially complete.

Schedule Assessment

This contract is substantially complete,

Risk Assessment

This contract is substantially complete.

FQA27 Arch Street Yard & Shop – Amtrak F/A

FQL27 Arch Street Yard & Shop – LIRR F/A

FQN27 Arch Street Yard & Shop – NYAR F/A

Scope Assessment

The scope for these contracts is for Amtrak and NYAR to provide force account resources for flag protection for the Contract CQ027 contractor employees working within the fouling limits of train operations. LIRR will provide force account resources to perform inspection, testing and acceptance of the yard facility. The scope is consistent with the FEIS.

Cost Assessment

The PMOC reviewed the entire cost estimate and found the process for the formulation of the estimate to be sound – see page14 Review of ESA Cost Estimating Methodology.

Schedule Assessment

PMOC reviewed the ESA’s Integrated Project Schedule (IPS) for reasonableness of scope, time and risk. The IPS identifies major components of the project, including this contract. The contractor will prepare a detailed schedule based on the IPS which will define durations and inter-relationships. The IPS schedule represents a reasonable estimate of work tasks and inter-contract relationships.

Risk Assessment

Risks associated with this work include:

- Lack of Amtrak resources
- Lack of NYAR resources
- Lack of LIRR resources
- Delay in stage completion by third party contractor

FQA28 Queens Open – Cut Excavation and Tunnel under Northern Boulevard – Amtrak F/A

FQL28 Queens Open – Cut Excavation and Tunnel under Northern Boulevard – LIRR F/A

FQN28 Queens Open – Cut Excavation and Tunnel under Northern Boulevard – NYAR F/A

FQT28 Queens Open – Cut Excavation and Tunnel under Northern Boulevard – NYCT F/A

Scope Assessment

The scope for these contracts is to provide force account resources to support the CQ028 contractor during construction. Amtrak, NYAR and NYCT will provide flag protection for contractor employees working within the fouling limit of train operations. LIRR will perform inspection of construction, as required. NYCT will also monitor their facilities during slurry wall and excavation operations for the BMT/IND operations. The scope is consistent with the FEIS.

Cost Assessment

The PMOC reviewed the entire cost estimate and found the process for the formulation of the estimate to be sound – see page 14 Review of ESA Cost Estimating Methodology.

Schedule Assessment

PMOC reviewed the ESA's Integrated Project Schedule (IPS) for reasonableness of scope, time and risk. The IPS identifies major components of the project, including these contracts. The contractor will prepare a detailed schedule based on the IPS which will define durations and inter-relationships. The IPS schedule represents a reasonable estimate of work tasks and inter-contract relationships.

Risk Assessment

Risks associated with this work include:

- Lack of Amtrak resources
- Lack of LIRR resources
- Lack of NYAR resources
- Lack of NYCT resources
- Delay in stage completion by third party contractor

FQA31 Queens Bored – Tunnels & Structures – Amtrak F/A

FQL31 Queens Bored – Tunnels & Structures – LIRR F/A

FQN31 Queens Bored – Tunnels & Structures – NYAR F/A

Scope Assessment

The scope for these contracts is for Amtrak, LIRR and NYAR to provide force account resources for flag protection for the Contract CQ031 contractor employees working within the fouling limits of train operations and during construction of the TBM launch shaft. The scope is consistent with the FEIS.

Cost Assessment

The PMOC reviewed the entire cost estimate and found the process for the formulation of the estimate to be sound – see page14 Review of ESA Cost Estimating Methodology.

Schedule Assessment

PMOC reviewed the ESA's Integrated Project Schedule (IPS) for reasonableness of scope, time and risk. The IPS identifies major components of the project, including these contracts. The contractor will prepare a detailed schedule based on the IPS which will define durations and inter-relationships. The IPS schedule represents a reasonable estimate of work tasks and inter-contract relationships.

Risk Assessment

Risks associated with this work include:

- Lack of Amtrak resources
- Lack of LIRR resources
- Lack of NYAR resources
- Delay in stage completion by third party contractor

FQA32 Tunnel Structure at Existing Rail Yard – Amtrak F/A

FQL32 Tunnel Structure at Existing Rail Yard – LIRR F/A

FQN32 Tunnel Structure at Existing Rail Yard – NYAR F/A

Scope Assessment

The scope for these contracts is to provide force account resources to support the CQ032 contractor during construction. Amtrak and NYAR will provide flag protection for contractor employees working within the fouling limit of train operations. LIRR will perform inspection of construction, as required. The scope is consistent with the FEIS.

Cost Assessment

The PMOC reviewed the entire cost estimate and found the process for the formulation of the estimate to be sound – see page14 Review of ESA Cost Estimating Methodology.

Schedule Assessment

PMOC reviewed the ESA's Integrated Project Schedule (IPS) for reasonableness of scope, time and risk. The IPS identifies major components of the project, including these contracts. The contractor will prepare a detailed schedule based on the IPS which will define durations and inter-relationships. The IPS schedule represents a reasonable estimate of work tasks and inter-contract relationships.

Risk Assessment

Risks associated with this work include:

- Lack of Amtrak resources
- Lack of LIRR resources
- Lack of NYAR resources
- Delay in stage completion by third party contractor

FQA33 **Mid-Day Storage Yard Facility – Amtrak F/A**

FQL33 **Mid-Day Storage Yard Facility – LIRR F/A**

FQN33 **Mid-Day Storage Yard Facility – NYAR F/A**

Scope Assessment

The scope for these contracts is to provide force account resources to support the CQ033 contractor during construction. Amtrak and NYAR will provide flag protection for contractor employees working within the fouling limit of train operations. LIRR will inspect civil work and test and accept systems elements. The scope is consistent with the FEIS.

Cost Assessment

The PMOC reviewed the entire cost estimate and found the process for the formulation of the estimate to be sound – see page 14 Review of ESA Cost Estimating Methodology.

Schedule Assessment

PMOC reviewed the ESA's Integrated Project Schedule (IPS) for reasonableness of scope, time and risk. The IPS identifies major components of the project, including these contracts. The contractor will prepare a detailed schedule based on the IPS which will define durations and inter-relationships. The IPS schedule represents a reasonable estimate of work tasks and inter-contract relationships.

Risk Assessment

Risks associated with this work include:

- Lack of Amtrak resources
- Lack of LIRR resources
- Lack of NYAR resources
- Delay in stage completion by third party contractor

FQA34 Sunnyside Passenger Station – Amtrak F/A

FQL34 Sunnyside Passenger Station – LIRR F/A

Scope Assessment

The scope for these contracts is for Amtrak and LIRR to provide force account resources for flag protection for the Contract CQ034 contractor employees working within the fouling limits of train operations. The scope is consistent with the FEIS.

Cost Assessment

The PMOC reviewed the entire cost estimate and found the process for the formulation of the estimate to be sound – see page14 Review of ESA Cost Estimating Methodology.

Schedule Assessment

PMOC reviewed the ESA’s Integrated Project Schedule (IPS) for reasonableness of scope, time and risk. The IPS identifies major components of the project, including these contracts. The contractor will prepare a detailed schedule based on the IPS which will define durations and inter-relationships. The IPS schedule represents a reasonable estimate of work tasks and inter-contract relationships.

Risk Assessment

Risks associated with this work include:

- Lack of Amtrak resources
- Lack of LIRR resources
- Delay in stage completion by third party contractor

FQL35 Wood Interlocking – LIRR F/A

Scope Assessment

The scope for this contract requires LIRR to provide force account resources for work in the Wood Interlocking, including procuring and installing rail, third-rail, signal instrument houses and signal bridges; performing final design of CIL equipment and communications equipment; reviewing final design of the signaling system; modifying the Jamaica Control Center; and testing and commissioning the Wood Interlocking. The scope is consistent with the FEIS.

Cost Assessment

The PMOC reviewed the entire cost estimate and found the process for the formulation of the estimate to be sound – see page14 Review of ESA Cost Estimating Methodology.

Schedule Assessment

PMOC reviewed the ESA’s Integrated Project Schedule (IPS) for reasonableness of scope, time and risk. The IPS identifies major components of the project, including these

contracts. The contractor will prepare a detailed schedule based on the IPS which will define durations and inter-relationships. The IPS schedule represents a reasonable estimate of work tasks and inter-contract relationships.

Risk Assessment

Risks associated with this work include:

- Lack of LIRR resources
- Delay in material procurement

FQA36 Arch Street Yard Connection – Amtrak F/A

Scope Assessment

The scope for this contract is for Amtrak to provide force account resources to construct the Amtrak portion of the Arch Street Yard connection route, including grading, signaling, communications, track, special trackwork and catenary modifications. Amtrak will also provide rail connection from the Arch Street Yard to the mainline track. The scope is consistent with the FEIS.

Cost Assessment

The PMOC reviewed the entire cost estimate and found the process for the formulation of the estimate to be sound – see page 14 Review of ESA Cost Estimating Methodology.

Schedule Assessment

PMOC reviewed the ESA's Integrated Project Schedule (IPS) for reasonableness of scope, time and risk. The IPS identifies major components of the project, including this contract. The contractor will prepare a detailed schedule based on the IPS which will define durations and inter-relationships. The IPS schedule represents a reasonable estimate of work tasks and inter-contract relationships.

Risk Assessment

Risks associated with this work include:

- Delay in material procurement by LIRR of long-lead items for installation by Amtrak
- Lack of Amtrak resources
- Delay in stage completion by third party contractor.

FQL36 Arch Street Yard Connection – LIRR F/A

Scope Assessment

The scope for this contract is for LIRR to provide force account resources to construct the LIRR portion of the Arch Street Yard connection route, including grading, third-rail, signaling, communications, track and special trackwork modifications. LIRR will also

procure long-lead items to be installed by Amtrak and provide rail connection from the Arch Street Yard to the mainline track. The scope is consistent with the FEIS.

Cost Assessment

The PMOC reviewed the entire cost estimate and found the process for the formulation of the estimate to be sound – see page14 Review of ESA Cost Estimating Methodology.

Schedule Assessment

PMOC reviewed the ESA's Integrated Project Schedule (IPS) for reasonableness of scope, time and risk. The IPS identifies major components of the project, including this contract. The contractor will prepare a detailed schedule based on the IPS which will define durations and inter-relationships. The IPS schedule represents a reasonable estimate of work tasks and inter-contract relationships.

Risk Assessment

Risks associated with this work include:

- Lack of LIRR resources
- Delay in stage completion by third party contractor.

FQA40 Amtrak Buildings Demolition & Relocation – Amtrak F/A

Scope Assessment

The scope for this contract is for Amtrak to provide force account resources for flag protection for the Contract CQ040 contractor employees working within the fouling limits of train operations. The scope is consistent with the FEIS.

Cost Assessment

The PMOC reviewed the entire cost estimate and found the process for the formulation of the estimate to be sound – see page14 Review of ESA Cost Estimating Methodology.

Schedule Assessment

PMOC reviewed the ESA's Integrated Project Schedule (IPS) for reasonableness of scope, time and risk. The IPS identifies major components of the project, including this contract. The contractor will prepare a detailed schedule based on the IPS which will define durations and inter-relationships. The IPS schedule represents a reasonable estimate of work tasks and inter-contract relationships.

Risk Assessment

Risks Associated with this work include:

- Lack of Amtrak resources
- Delay in stage completion by third party contractor

FQA64 Q Interlocking & Yard Access – Amtrak F/A

Scope Assessment

The scope for this contract is for Amtrak to provide force account resources for Q Interlocking Modifications, including installation of Q Tower House and systems, QY1 and QY2, and demolition of the existing yard track and associated systems. The scope is consistent with the FEIS.

Cost Assessment

The PMOC reviewed the entire cost estimate and found the process for the formulation of the estimate to be sound – see page14 Review of ESA Cost Estimating Methodology.

Schedule Assessment

PMOC reviewed the ESA's Integrated Project Schedule (IPS) for reasonableness of scope, time and risk. The IPS identifies major components of the project, including this contract. The contractor will prepare a detailed schedule based on the IPS which will define durations and inter-relationships. The IPS schedule represents a reasonable estimate of work tasks and inter-contract relationships.

Risk Assessment

Risks associated with this work include:

- Lack of Amtrak resources
- Delay in stage completion by third party contractor.

FQA65 Loops Interlocking – Amtrak F/A

Scope Assessment

The scope for this contract is for Amtrak to provide force account resources for reconstruction of the Amtrak Washer area. It includes installing switches, washer systems and catenary; track cut-overs; Loop "A" connection including track, catenary, power and signals; completing northern section of Amtrak's Loop tracks including signals and catenary; and reconfiguring Loop Interlocking. The scope is consistent with the FEIS.

Cost Assessment

The PMOC reviewed the entire cost estimate and found the process for the formulation of the estimate to be sound – see page14 Review of ESA Cost Estimating Methodology.

Schedule Assessment

PMOC reviewed the ESA's Integrated Project Schedule (IPS) for reasonableness of scope, time and risk. The IPS identifies major components of the project, including this contract. The contractor will prepare a detailed schedule based on the IPS which will

define durations and inter-relationships. The IPS schedule represents a reasonable estimate of work tasks and inter-contract relationships.

Risk Assessment

Risks associated with this work include:

- Lack of Amtrak resources
- Delay in stage completion by third party contractor.

PROJECT-WIDE FORCE ACCOUNT CONTRACTS

FSA78 Track & Third-Rail on Direct Fixation – Amtrak F/A

FSL78 Track & Third-Rail on Direct Fixation – LIRR F/A

Scope Assessment

The scope for these contracts is for Amtrak and LIRR to provide force account resources for flag protection for the Contract CS078 contractor employees working within the fouling limits of train operations. LIRR will also inspect, test and commission interfaces with existing systems, as required. The scope is consistent with the FEIS.

Cost Assessment

The PMOC reviewed the entire cost estimate and found the process for the formulation of the estimate to be sound – see page14 Review of ESA Cost Estimating Methodology.

Schedule Assessment

PMOC reviewed the ESA's Integrated Project Schedule (IPS) for reasonableness of scope, time and risk. The IPS identifies major components of the project, including these contracts. The contractor will prepare a detailed schedule based on the IPS which will define durations and inter-relationships. The IPS schedule represents a reasonable estimate of work tasks and inter-contract relationships.

Risk Assessment

Risks associated with this work include:

- Lack of Amtrak resources
- Lack of LIRR resources
- Delay in stage completion by third party contractor

- FSA79 Power, Signals, Communications & Other System Elements – Amtrak
F/A**
- FSL79 Power, Signals, Communications & Other System Elements – LIRR
F/A**
- FSM79 Power, Signals, Communications & Other System Elements – MNR
F/A**

Scope Assessment

The scope for these contracts is for Amtrak, LIRR and MNR to provide force account resources for flag protection for the Contract CS079 contractor employees working within the fouling limits of train operations and also to inspect, test and commission interfaces with their existing systems as required. LIRR will also perform the work associated with interfacing into the LIRR controls (JCC). The scope is consistent with the FEIS.

Cost Assessment

The PMOC reviewed the entire cost estimate and found the process for the formulation of the estimate to be sound – see page14 Review of ESA Cost Estimating Methodology.

Schedule Assessment

PMOC reviewed the ESA's Integrated Project Schedule (IPS) for reasonableness of scope, time and risk. The IPS identifies major components of the project, including these contracts. The contractor will prepare a detailed schedule based on the IPS which will define durations and inter-relationships. The IPS schedule represents a reasonable estimate of work tasks and inter-contract relationships.

Risk Assessment

Risks associated with this work include:

- Lack of Amtrak resources
- Lack of LIRR resources
- Lack of MNR resources
- Delay in stage completion by third party contractor

FSL81 Tunnel Ventilation System – LIRR F/A

FST81 Tunnel Ventilation System -NYCT F/A

Scope Assessment

The scope for these contracts is for LIRR and NYCT to provide force account resources to support the work of the CS081 contractor. LIRR will inspect, test and commission interfaces with existing systems as required. NYCT will supply flag protection for

contractor employees working within the fouling limit of their train operations and also monitor contractor employees working within existing facilities. The scope is consistent with the FEIS.

Cost Assessment

The PMOC reviewed the entire cost estimate and found the process for the formulation of the estimate to be sound – see page14 Review of ESA Cost Estimating Methodology.

Schedule Assessment

PMOC reviewed the ESA's Integrated Project Schedule (IPS) for reasonableness of scope, time and risk. The IPS identifies major components of the project, including these contracts. The contractor will prepare a detailed schedule based on the IPS which will define durations and inter-relationships. The IPS schedule represents a reasonable estimate of work tasks and inter-contract relationships.

Risk Assessment

Risks associated with this work include:

- Lack of LIRR resources
- Lack of NYCT resources
- Delay in stage completion by third party

PROJECT-WIDE RISKS

The ESA project has numerous risks which affect more than one individual contract. Accordingly, they are not listed in the risk assessment write-up for each contract, but are identified here as project-wide risks. The risks are enumerated as follows:

Steel prices have increased dramatically over the past year. MTA has accounted for this increase and has forecast a 3% escalation factor per year in their latest estimates. A risk exists that the price increase escalates more than forecast (5-000-01).

Security is of utmost importance on this project. A risk exists of new security requirements from MTA as the design progresses (5-000-02).

Concrete prices have also increased of late. MTA has accounted for this increase and has added 10% on top of a 3% escalation factor per year in their latest estimates. A risk exists that the price increase escalates more than forecast (5-000-03).

A rolling stock increase of 180 cars is projected as the requirement for this project. The purchasing of cars is under evaluation. Issues being evaluated include when to purchase them (storage and maintenance concerns if purchased early) and under what contract with the manufacturer (either an extension of a present contract or the establishment of a new contract). A risk exists of the need for a new contract which could result in a cost increase and higher escalation (5-000-04).

MTA is self-insured with a \$100M Captive Railroad Protective policy. As a result, ESA has no liabilities except for Builders Risk. Payment for Builders Risk deductibles is a risk that exists (5-000-05).

Tunneling in Queens will require the construction of TBM reception pits within a confined area. Much coordination will be required between contracts CQ031, CH053 and CH054. A risk exists of the lack of availability of TBM reception pits due to staging/phasing of numerous contracts (5-000-06).

NYCDOT approval is required to underpin bridges and construct emergency exits in Queens. A risk exists of an untimely approval process by NYCDOT (5-000-07).

Work within the Harold Interlocking and Sunnyside Yard areas will be in the vicinity of plumes of hazardous material. MTA has obtained insurance coverage to cover costs related to environmental issues. A risk exists of movement of the contaminated plumes during construction operations (5-000-08).

There is much systems work to be performed with access reliance between contracts. Access is required to tunnels and rooms for the systems work. A risk exists of delays in gaining access to the tunnels and rooms for completing the systems work (5-000-09).

Contract CM004 constructs an entrance to the GCT from 245 Park Avenue. Much of the work is in the vicinity of MNR facilities. A risk exists that MNR unions may claim some of the work (5-000-10).

MNR provides force account resources in support of the CM004 contractor. MNR work includes a work train, relocation of utilities, removing existing rail and third rail, and relocation of a signal case. A risk exists of a lack of MNR resources for the force account direct work (5-000-11).

Contract CQ040 is the relocation and demolition of existing AMTRAK facilities buildings 3 and 4. An Amtrak agreement needs to be executed in order to perform this work. A risk exists of a delay in executing the agreement and thus an inability to relocate the buildings at a time frame to meet the project schedule requirements (5-000-12).

SUBTASK 22B - RISK ANALYSIS AND ASSESSMENT

OBJECTIVE

The PMOC conducted a cost risk analysis of the East Side Access Project (ESA) in accordance with FTA's Guidance 22. The objective of the analysis was to estimate the probability of cost overrun over the ESA's established budget. The project budget is broken down into 26 Third Party contracts located in Manhattan and Queens (CM001, CM004, CM008, CM009, CM012, CM013, CM014, CM015, CM016, CM017, CMS16, CS078, CS079, CS081, VS077, CQ025, CQ026, CQ027, CQ028, CQ031, CQ032, CQ033, CQ034, and CQ040, VQ064 and VQ065), Harold area contracts, Force Account contracts, vehicles, real estate, and soft costs. The project budget at the current time is \$6,305,757,000.

The risk analysis presented here considered the risk factors identified by the ESA and reviewed and augmented by PMOC prior to and during the risk assessment workshop conducted on October 5-6, 2004 in New York City. The outcome of the analysis is the Cumulative Distribution Function (CDF) of the total costs, calculated using Monte Carlo simulation. The CDF provides the range of possible outcomes for the project cost and can be used to assess the adequacy of contingencies and to calculate the probability of cost overrun.

MONTE CARLO SIMULATION APPROACH

The Monte Carlo approach is a well-known and well-established method for simulating various outcomes of costs. The simulation was repeated 10,000 times in this report and then a histogram of these 10,000 runs was developed. This histogram along with the cumulative histogram, i.e., the CDF of costs, can be used to calculate the probability of cost overrun for the ESA Project.

RISK WORKSHOP

A workshop was conducted on October 5th and 6th 2004 at the ESA Project headquarters in New York City. The workshop participants consisted of staff from MTA's in-house staff and consultants. These individuals used their collective knowledge of the project to develop the project risk register and to quantify the effects of these risks on project costs. The FTA and the PMOC acted as facilitators and contributed input to the discussions as appropriate. The following steps were taken to conduct the analysis.

- 1- Contingencies and escalation were removed from the project budget. The remaining costs were considered the base project costs.
- 2- The risk assessment team reviewed every item on the risk register and quantified the probability of occurrence and the range of costs and benefits that could affect project budget, positively or negatively.

- 3- Risk factors were modeled as triangular distributions. The triangular distribution approach is appropriate for modeling cost risks as it is flexible in modeling both symmetrical and skewed cost items and also has confined (finite) end points. Further, the MTA had estimated the costs and benefits of each risk using a three-estimate format that yielded naturally to the use of triangular distribution.
- 4- For each risk factor (note that a risk factor is any item that can potentially increase or decrease project costs) three estimates were elicited from the experts participating in the workshop. These estimates were the 5%, most likely, and 95% points on the cost distribution range as well as two other extrapolated points. These estimates have been traditionally used in previous risk analysis methodologies, provide a reasonable range for each risk factor, and are believed to produce robust results. We chose to elicit 5% and 95% points because it is usually more difficult to estimate extreme values of the distribution (0 and 100% points) subjectively from experts. The logic in choosing the triangular distribution and its characteristics was described to team members.
- 5- Correlations were considered in the simulation model by grouping risks that affect more than one contract under project-wide, tunnels/caverns, Harold, etc. Correlations between individual risk factors affecting individual projects such as CM008, CM009, etc were not considered. This is not a conservative assumption but was necessary because trying to estimate correlations among individual risk factors was prone to too much uncertainty.
- 6- The escalation factor was modeled as a random variable because of its volatility in the past two years. By reviewing the values of cost escalation using various construction cost indices, PMOC decided to assume an average annual escalation factor of 3.5% (consistent with FTA's practice in current projects) with a standard deviation of 2.45%. This gives a coefficient of variation of 0.7 (coefficient of variation is the ratio of standard deviation to mean (average) of the escalation). Although this value is too low given escalation factors of the past two years, we felt that for the duration of the project (8 years), we were not prepared to assume a higher escalation factor because there was always a possibility of lower escalation rates compared to the recent jump in costs.

In order to show the variation in escalation rates, a normal distribution was assumed for modeling escalation rate with mean 3.5% and standard deviation 2.45%. A random value is generated for the first year using the normal distribution. For the consequent year, an escalation factor is generated using a normal distribution with the mean assumed to be the value generated for the previous year and standard deviation of 2.45%. This process is repeated for future years. Then, an average value is calculated for the generated rates covering the duration of each individual project. For example, if a contract is scheduled between 2006 and 2008, the values of escalation generated for 2006, 2007, and 2008 are averaged and used as escalation factor for that specific contract. This is the probabilistic equivalent of calculating the escalation factor to the *midpoint* of the contract duration.

SIMULATION

Using @RISK™ software package (with Excel spreadsheet), the project costs, risks, and escalation was simulated for 10,000 iterations. The results of the simulation are given in Table 3.

Table 3 – Cumulative Probabilities of Total Project Costs

Cumulative percentile (%)	Total Project Cost (\$) Monte Carlo Simulation
10	5,158,816,768
25	5,462,289,408
50	5,838,640,640
75	6,243,097,088
90	6,651,570,688

The analysis shows that the project with its current level of funding has a 78% chance of finishing within budget. Figure 1 shows the histogram and Figure 2 shows the CDF of the simulated costs.

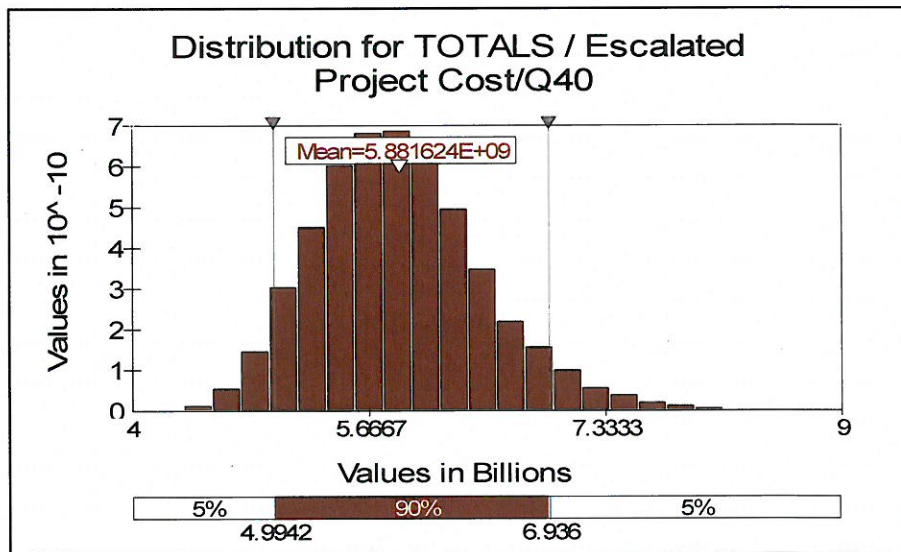


Figure 1 – The Histogram of Total Project Costs

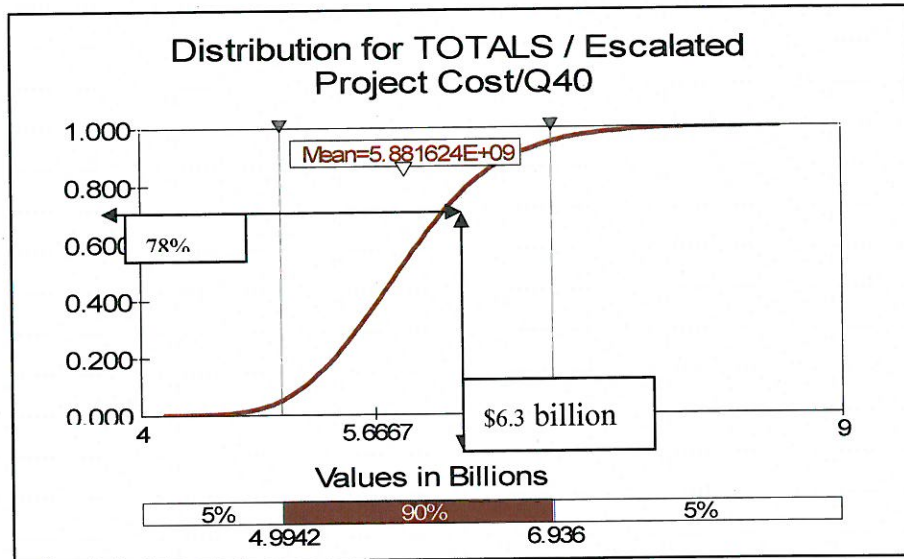


Figure 2 – The CDF of Total Project Costs

RANKING OF PRE-MITIGATION RISKS AND OPPORTUNITIES

In order to rank various risk factors, expected values (averages) of risk factors were compared. This ranking shows the potential of various risk factors for variability of the total costs. For example, the most critical risk factors that can adversely affect costs, by far is the escalation factor used in the analysis, followed by the possibility of cost escalation due to unit cost increase for vehicles. Table 3 only considers risk factors with expected values of over \$2.5m.

Table 3 – Most Critical Risk Factors

Rank	Contract	Risk #	Risk Description	Expected risk
1	Project-wide		Cost escalation	
2	Project-wide	5-000-04	Unit cost increase for rolling stock	\$66,063,958.00
3	CM015	1-015-03	Building owner opposition to property taking	\$10,000,000.00
4	Project-wide	5-000-05	OCIP - Change in coverage	\$ 9,035,441.98
5	Harold	3-000-14	Change in alignment due to AMTRAK	\$ 5,999,999.87
6	CS079	4-079-05	Lack of competition	\$ 5,537,208.40
7	Harold	3-000-07	Lack of AMTRAK resources	\$ 4,421,990.40
8	CM09	1-009-01	Differing Site Condition	\$ 3,898,482.51
8	CM012	1-012-01	Increased blasting restrictions due to MNR concerns	\$ 3,898,482.51
8	CQ031	2-031-03	TBM unable to mine ground to meet schedule	\$ 3,898,482.51
11	Project-wide	5-000-01	Steel price increase	\$ 3,671,994.88
12	Project-wide	5-000-02	New security requirements from MTA	\$ 3,518,160.37

*Risk Assessment Study
East Side Access Project*

Rank	Contract	Risk #	Risk Description	Expected risk
13	CM014	1-014-03	MTA establishes unified ops policy	\$ 3,452,918.51
14	CM014	1-014-01	Inadequate access to caverns	\$ 3,378,575.87
15	CM09	1-009-02	TBM unable to mine ground to meet schedule	\$ 2,768,604.20
15	CS079	4-079-02	RR increases requirements for systems elements	\$ 2,768,604.20
15	CQ031	2-031-01	Geotechnical DSC encountered	\$ 2,768,604.20

Table 4 below gives the ranking of the top three opportunity factors.

Table 4

Rank	Contract	Risk#	Risk Description	Expected Opportunity
1	Harold	OP-02	Establish work zones to reduce A&P costs	\$ (4,648,486.37)
2	CM015	OP-01	Defer 44th St Entrance	\$ (2,213,230.38)
3	Tunnels/Caverns	OP-05	Shotcrete as final liner in non-uniform sections	\$ (1,273,523.46)

SUBTASK 22C – PROJECT CONTINGENCY REVIEW

This section describes and addresses the adequacy of the project cost and schedule contingencies.

CONTINGENCY ANALYSIS

The total project contingency consists of various elements that ESA has established and allocated to line items in the budget, as well as a pool of unallocated contingency. The following table (Table 5) outlines the contingency allocated to the budget line items.

	Contingency Type	\$ M
1	Construction contracts pre-bid contingency	309.5
2	Construction contracts post-bid contingency	256.3
3	Access & Protection contracts contingency	15.4
4	Engineering contingency	2.0
5	Program Management contingency	22.0
6	Management Reserve	152.7
	Total	757.9

Table 5

Construction contracts pre-bid contingency – The amount of \$309.5 million represents approximately 9.3% of the total of direct construction cost estimates, with ranges between 2% and 17% on the individual contract packages. This amount is meant to cover risks that the contractors would include in their bid price.

Construction contracts post-bid contingency – The amount of \$256.3 million represents approximately 6.3% of the total of construction costs, including escalation and pre-bid contingency. The range on the individual contract packages is between 5% and 10%. This amount is meant to cover unknown and unanticipated project conditions which would result in additional work order (extras) to the contractor.

Access and Protection contracts contingency – The amount of \$15.4 million represents approximately 14.4% of the direct costs for railroad access and protection activities. This amount is meant to cover unknown and unanticipated project conditions which would result in additional charges from the railroads.

Engineering contingency – The amount of \$2.0 million represents approximately 0.5% of the engineering budget.

Program Management contingency – The amount of \$22 million represents approximately 5% of the Program Management budget.

Management Reserve – The amount of \$152.7 million represents approximately 2.4% of the total project budget of \$6305.76 million. The management reserve serves as a pool of other contingencies not specifically designated above.

Overall, the total of contingencies, \$757.9 million, represents approximately 12% of the total project budget of \$6.3 billion. The PMOC has used information contained in the August 2004 estimate in order to extract this total and its components (shown in items 1 through 6 above). It should be noted that Attachment 3 of the FFGA, prepared by the ESA team, shows a total of \$802.5 million in project contingencies (12.7% of the \$6.3 billion budget).

There is a 78% confidence level that the budget will be met, which indicates that there is a 22% chance the contingency will overrun. The major uncertainty in the budget is the escalation.

The total contingency and escalation budget serve to reduce the probability of a project cost overrun. A risk profile for the project is given in Figure 3 below.

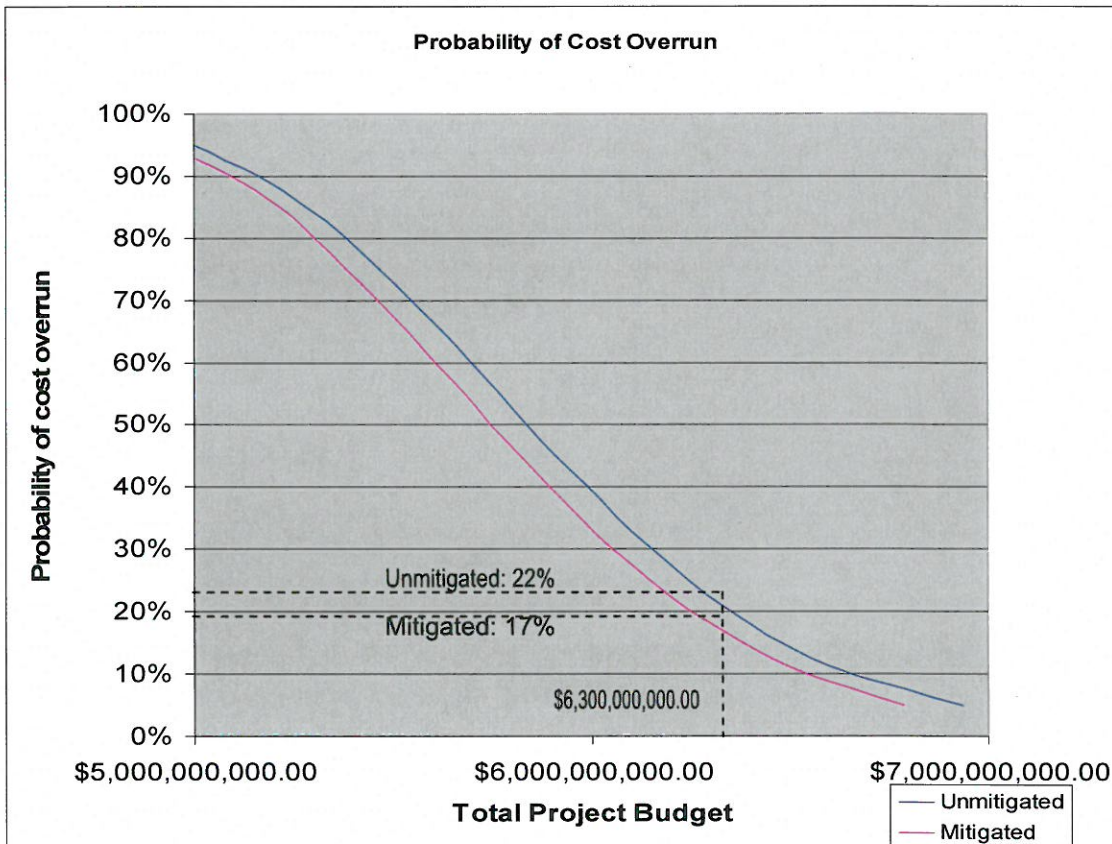


Figure 3

In the PMOC's opinion, the level of contingency is adequate for the scope of the project and the current status of the project.

SCHEDULE RISK ANALYSIS

The following briefly describes our Monte Carlo simulation analysis of the ESA Project Schedule:

PROJECT SCHEDULE

The ESA developed a macro-level network schedule of the ESA Project based on the IPS consisting of 154 activities. The schedule is prepared at a sufficient level of detail to allow a meaningful schedule risk analysis. The PMOC reviewed the schedule and estimated ranges for activities that had potential for variability. The ESA estimated these ranges and discussed them with PMOC. Table 6 gives the ranges for the network activities. For each activity a most likely duration was estimated and used in the deterministic CPM analysis in the program network. The last two columns in Table 6 give the potential variation of each activity with respect to the most likely duration in calendar months. For simulation modeling each calendar month was assumed to be equivalent to 22 working days.

Table 6 – Activities with uncertain durations

Activity ID	Activity description	Range	
		Low End (time gained in months)	High End (time lost in months)
FMM02FA	East Yard Track & Signal Modifications	0	0
CM004PA	245 Park Ave Entrance	0	0
CM008UR	Utility Relocations - GCT Lower Level	-2.0	1.0
CM00840	Demolish 47 E. 44th Building	-1.0	2.0
CM008DM	Demolition at Lower Level GCT	-1.0	1.0
CM008Z4	Reframing Escalator No. 4 - 48th St.	-0.5	0.5
CM008Z1	Reframing Escalator No. 1 - 45th St.	-0.5	0.5
CM008Z3	Reframing Escalator No. 3 - 47th St.	-1.0	0.5
CM008Z2	Reframing Escalator No. 2 - 46th St.	-1.0	0.5
FMM08M1	Madison Yard Decommissioning	-1.0	2.0
CCM009X100	Manufacture and Deliver TBMs	-1.0	1.0
CM009TP	Outfit Ex. 63rd St. Tnl & Assembly Chamber	-2.0	0.5
CCM009X110	Assemble TBM A	-0.5	0.5
CCM009X300	Assemble TBM B	-0.5	0.5
CCM009X120	TBM 1A WB Lower from Assembly to 38 th	-1.0	0.5
CCM009X310	TBM 1B EB Lower from Assembly to 38th	-1.0	0.5
CCM009X130	D&B Exc. GCT 5 WYE WB & Starter Tnl (10,407 bcy)	-0.5	1.0

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CCM009X320	D&B Exc. GCT 5 WYE EB & Starter Tnl (10,407 bcy)	-0.5	1.0
CCM009X160	Backup & Re-Assemble TBM A at 59th St	0.0	0.5
CCM009X170	TBM 2A - #15 Upper WB WYE to 38th (5,357 TF)	-1.0	0.5
CCM009X350	Backup & Re-Assemble TBM B at 59th St	0.0	0.5
CCM009X480	D&B Excavate GCT 4 West WYE (7,890 bcy)	-0.5	0.5
CCM009X500	D&B Excavate GCT 4 East WYE (7,890 bcy)	-0.5	0.5
CCM009X360	TBM 2B - #15 EB WYE to Upper 38th (5,241 TF)	-1.0	0.5
CCM009X190	Backup & Reassemble TBM A at Lower WB#10 WYE	0.0	0.5
CCM009X210	TBM 3A Lower WB from #10 WYE to 43rd (1,581 TF)	-1.0	0.5
CCM009X490	D&B Excavate GCT 3 West WYE (6,172 bcy)	-0.5	0.5
CCM009X390	Backup & Re-Assemble TBM B at Lower EB#10 WYE	0.0	0.5
CCM009X510	D&B Excavate GCT 3 East WYE (6,172 bcy)	-0.5	0.5
CCM009X220	Disassemble & Backup TBM A at Lower WB 43th St	0.0	0.5
CCM009X400	TBM 3B Lower EB from #10 WYE to 43rd (1,582 TF)	-1.0	0.5
CCM009X250	TBM 4A WB Upper from #10 WYE to 43rd (1,411 TF)	-1.0	0.5
CCM009X430	Backup & Re-Assemble TBM B at Upper EB#10 WYE	0.0	0.5
CCM009X520	D&B Exc. Lower Crossover Muck-out WB (9,133 bcy)	-0.5	0.5
CCM009X260	Backup & Disassemble TBM A at Upper WB 43th St	0.0	0.5
CCM009X440	TBM 4B EB Upper from #10 WYE to 43rd (1,407 TF)	-1.0	0.5
CCM009X450	Backup & Disassemble TBM B at Upper EB 43th St	0.0	0.5
CM012Z7	Shaft No. 2 - 45th St. Stair / Utility	-1.0	2.0
CM012Z1	Excavate & Line Escalatorways	-1.0	2.0
CM012Z8	Shaft No. 3 - 47th St. Stair / Elevator	-1.0	2.0
CM012Z6	Shaft No. 1 - 44th St. Vent Shaft	-1.0	2.0
CM012Z9	Shaft No. 4 - 48th St. Stair / Elevator	-1.0	2.0
CM012ZA	Shaft No. 5 - 48th St. Vent Shaft	-1.0	2.0
CM012TK	Tail-Track Excavation	-1.0	1.0

CCM0120470	Turnover Lower Level GCT To CM014 w/o Escalators		
CCM0121570	NTP & Mobilize Site - CM012		
CM012CW	West Caverns - Excavation	-1.0	3.0
CM012CE	East Caverns - Excavation (Includes Top Arch)	-1.0	3.0
CM012TJ	Tail-Track Concrete	-1.0	1.0
CM012TA	TBM Appr. Tunnel, Single Level Wyes & Crossovers	-2.0	1.0
CM012CW10	West Caverns - Concrete	-2.0	2.0
CM012CE10	East Caverns - Concrete	-2.0	2.0
CCM0121610	Turnover Caverns to CM014		
CCM0121880	CM012 - Caverns Concrete Complete		
CCM0121580	CM012 Substantial Completion		
CM013ZF	50th Street Vent Plant	-1.0	1.0
CM013FV	55th Street Vent Plant	-1.0	1.0
CM013VT	38th Street Vent Plant	-1.0	1.0
CM014EE10	Procure & Fabricate Escalators/Elevators	-1.0	4.0
CM014CO	Concourse Mech, Elec & Arch Finishes	-3.0	3.0
CM014GV	48th Street Vent Plant	-1.0	1.0
CM014VF	50th Street Vent Plant	-1.0	1.0
CM014EE	Installation of Escalators/Elevators	-2.0	4.0
CM014ET	East Trainroom Mech, Elec & Arch Finishes	-1.0	2.0
CM014MZ	Trainroom Mezzanine Mech, Elec & Arch Finishes	-1.0	2.0
CM014WT	West Trainroom Mech, Elec & Arch Finishes	-1.0	2.0
CM015EM	335 Madison Ave Entrance at 44th Street	-2.0	4.0
CM01545	415 Madison Avenue	-2.0	4.0
CM015EN	347 Madison Ave Entrance at 45th Street	-2.0	4.0
CQ027CS	Arch Street Yard & Shop	0.0	4.0
CQ028OC	Open-Cut Excavation & Structure	-2.0	2.0
CQ028UT	Underpinning & Tunnel under N. Blvd	-1.0	3.0
CQ028UT10	CQ028 Turnover Access to CQ031 Contractor		
CQ031MD10	CQ031 - Notice to Proceed		
CQ031MD20	Mobilization	0.0	0.0
CQ031TP	Manufacturer & Deliver TBMs/Liners	-1.0	2.0
CQ031SS	Substation 1A Demolition	-1.0	1.0
CQ031MD	Matura Property Demo	-2.0	0.0

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CQ031QW	Queens - Launch Wall	-1.5	1.5
CQ031QD	Emergency Exit - A, B/C & YL - Slurry Walls	-1.0	2.0
CQ031YL	Yard Lead Reception Pit & Approach	-2.0	1.0
CQ031QE	Emergency Exit - 39th Street - Slurry Walls	-1.0	2.0
CQ031QF	Emergency Exit - D Slurry Walls	-1.0	2.0
CQ031QW10	Assemble TBMs	-1.0	1.0
CQ031QT	Bored Tunnels - TBM#1 (YL & B/C)	-2.0	1.0
CQ031QU	Bored Tunnels - TBM#2 (A & D)	-2.0	1.0
CQ031QL	Tunnel Invert/Walkway	-2.0	1.0
CQ031QR	Tunnel Chamber Roofs	-1.0	1.0
CQ031QE10	Emergency Exit - 39th Street - Excavation & Conc	-1.0	1.0
CQ031QD10	Emer Exit - A, B/C , YL/Facilities - Exc & Conc	-1.0	1.0
CQ031QF10	Emergency Exit - D Excavation & Concrete	-1.0	1.0
CQ03206	Traction Power Facility Substation Structure	-2.0	2.0
CCQ032-100	*CM012 Cavern Excavation Complete*		
CCQ032-160	Access to Launch Area for Tunnel Structure Const		
CQ042CC10	Complete Lower Level Tunnel/Structure	-2.0	1.0
CCQ032-180	Coordinate LL Trackways Access w/CS078		
CQ032YS	Yard Services Bldg	-1.0	1.0
CCQ033-160	Procure Car Wash Equipment	-1.0	2.0
CCQ033-170	Install Car Wash Facility	-1.0	2.0
CCQ033-180	MDS Yard Track/Systems - Arch St to Open-Cut	-2.0	2.0
CCQ033-210	MDS Yard Track/Systems - Open-Cut to YL Approach	-1.0	1.0
CQ034CC	Construct Sunnyside Station	-2.0	3.0
FFQL35-110	NTP Wood Interlocking		
FFQL35-130	Wood Interlocking (Procure/Install) - F/A Direct	-1.0	3.0
FFQL35-380	FQL35 Substantial Completion		
FFQA36-110	Arch Street Yard Access - Amtrak Direct FA	0.0	4.0
FQL36FA	Arch Street Yard Access - LIRR Direct FA	-2.0	2.0
CQ040SY	Sunnyside Bldgs Demolition	-2.0	1.0
FQA64FA	Q Interlocking & Yard Access - Amtrak F/A	-1.0	2.0
VQ064VS	Procure Q Interlocking CIL	-1.0	2.0
FQA65FA	Loop Interlocking - Direct F/A	-1.0	2.0

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VQ065VS	Loop Interlocking CIL	-1.0	2.0
VH051VS	Procure Harold & Point CIL	-1.0	2.0
CH053DM	Demolition	-0.5	1.0
CH053RW	Retaining Walls	-1.0	2.0
CH053UL	Utility Relocations	-1.0	2.0
CH053B1	43rd Street Bridge	-1.0	1.0
CH053AP	Track A Reception Pit & Approach Structures	-1.0	2.0
CH054B11	Mobilization	0.0	0.0
CH054B1	43rd Street Bridge	-1.0	1.0
CH054DP	Track D Reception Pit & Approach Structures	-2.0	2.0
CH059L3	Loop Tracks & Car Washer	-1.0	2.0
CH059FB	48th Street Bridge Structure	-1.0	1.0
CH059AS	Tracks B/C Approach & Pit Roof Structure	-1.0	2.0
VH055VS	Procure SES	0.0	0.0
CH060CC	Cross Connector	-1.0	2.0
FHA01FA	Amtrak Harold F/A Stage 1 Construction	-2.0	2.0
FHL01FA	LIRR Harold F/A Stage 1 Construction	-2.0	2.0
FHA02FA	Amtrak Harold F/A Stage 2 Construction	-2.0	2.0
FHL02FS	LIRR Harold F/A Stage 2 Construction	-2.0	2.0
FHA03FA	Amtrak Harold F/A Stage 3 Construction	-2.0	2.0
FHL03FS	LIRR Harold F/A Stage 3 Construction	-2.0	2.0
FHA04FS	Amtrak Harold F/A Stage 4 Construction	-2.0	2.0
FHL04FA	LIRR Harold F/A Stage 4 Construction	-2.0	2.0
VS077VS	Procure Rail Fasteners	-2.0	1.0
CCS078X480	Install Trackwork - Lower 38th St to GCT 2	-0.5	0.5
CCS078X490	Install Trackwork - Upper 38th St to GCT 1	-0.5	0.5
CS078TY	Queens Trackwork	-1.0	2.0
CCM012S120	Approach Tunnel Conc Compl - Turnover to CS078		
CCS078X460	Install Trackwork - York to Plaza (East)	-1.0	2.0
CCS078-220	Complete Queens Tunnel Trackwork		
CCS078X470	Install Trackwork - Lower GCT 2 to GCT4	0.0	0.0
CCS078X530	Install Trackwork - Upper GCT 1 to GCT 3	0.0	0.0
CCS078X540	Install Trackwork - York to Plaza (West)	-1.0	2.0
CCS078-240	Complete Manhattan Trackwork		
CS079SQ	Queens Systems	-2.0	2.0

CCS079-260	SPE Manhattan Facilities - No. Cavern to 38th	-1.0	2.0
CCS079-280	Manhattan Wayside Signal Installations	0.0	2.0
CCS079-250	SPE Manhattan Facilities - Plaza to No. Cavern	-1.0	2.0
CCS079-230	Manhattan Local System Testing	0.0	1.0
CS081CS	CS081 - Tunnel Ventilation System Procurement	-2.0	2.0
CS081CS10	CS081 - Tunnel Ventilation System Installations	-4.0	2.0
SU00000020	Projectwide Start-up, Testing & Commissioning	0.0	2.0
SU00000046	Begin LIRR Revenue Service to GCT		

SIMULATION MODEL

The project schedule network had been prepared in Primavera Project Planner™ software. The schedule was first converted to MS Project™ format so that the risk analysis software (@Risk for Project™) can be utilized. Every single activity was checked to assure the correct conversion to MS Project. Because of conversion problems, some activities' start or finish times were not converted exactly; however, in no case was the difference in dates exceeded by more than two weeks. In each case, we assumed that the *most likely* duration is the duration obtained from the network schedule and a *triangular distribution* was used to model activities listed in Table 6 above. The output for the risk model was specified as the finish date for the project. The deterministic schedule gave an early finish date of May 30, 2012. The last activity, "Begin LIRR Revenue Service to GCT," was modeled with a finish-no-later-than-June-29-2012 constraint, in the network prepared by the MTA. Because of this constraint, the critical activities had a float of 22 days (one calendar month). We had to remove this constraint so that the simulation process can determine the finish time for the project.

SIMULATION RESULTS

The model for the network schedule was run for 10,000 iterations. The histogram for project finish time is given in Figure 4. As can be seen, the average (mean) finish date is simulated as August 29, 2012. A 90% confidence interval for the finish date is between June 28, 2012 and November 7, 2012.

Figure 4 – Histogram for the Project Finish Date

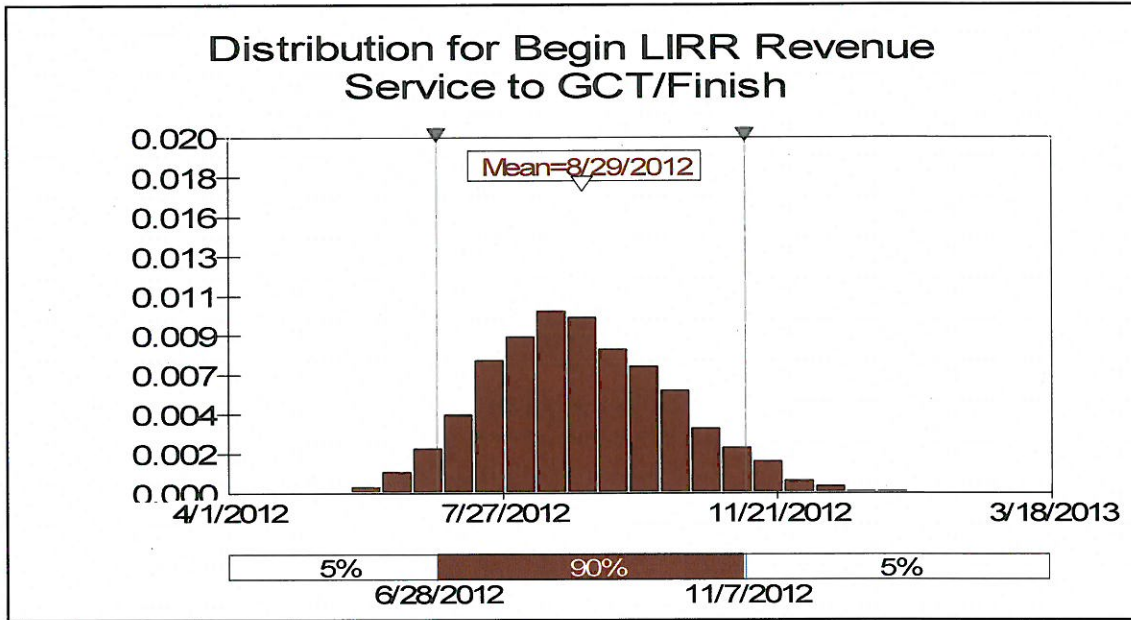


Figure 5 illustrates the cumulative distribution function (CDF) for the project completion date. Table 7 provides the same information. It can be seen that there is an 80% probability that the finish date will be on or before October 2, 2012. The earliest simulated finish time is April 26, 2012, and the latest simulated finish time is February 11, 2013. It needs to be stressed that the probability of these extreme values being realized is close to zero. The standard deviation for the project finish time is simulated as 40 working days. For a project of this size, this value is small and is an indication that the potential variables detected do not vary the completion date to a large degree.

Figure 5 – Cumulative distribution for finish time

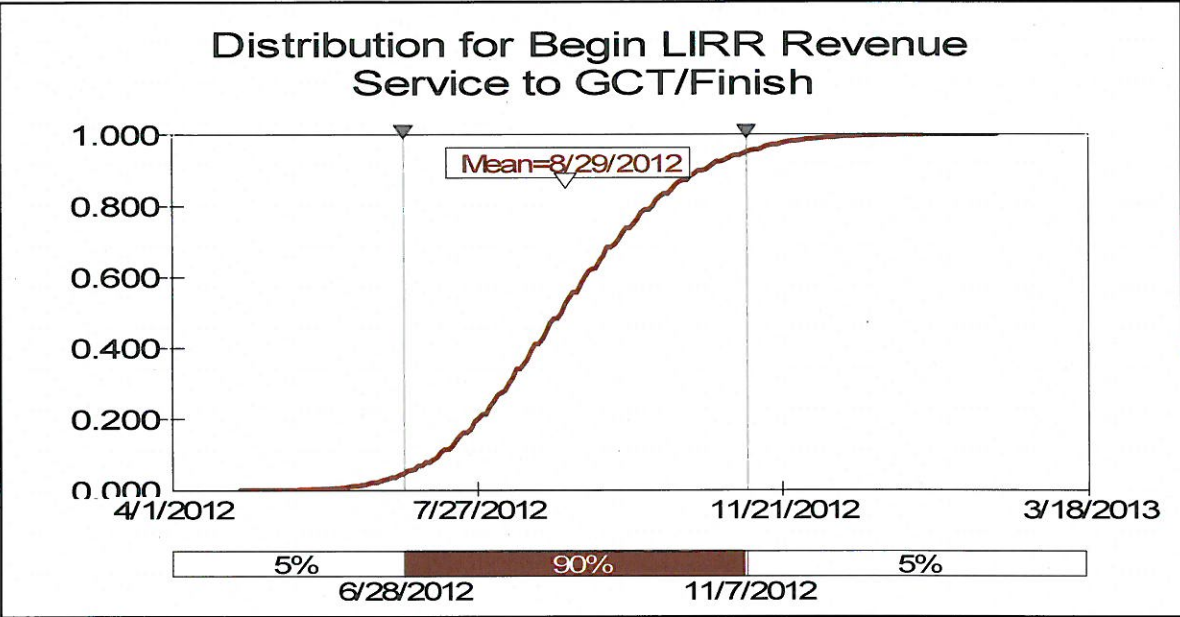


Figure 5A – Cumulative distribution for finish time

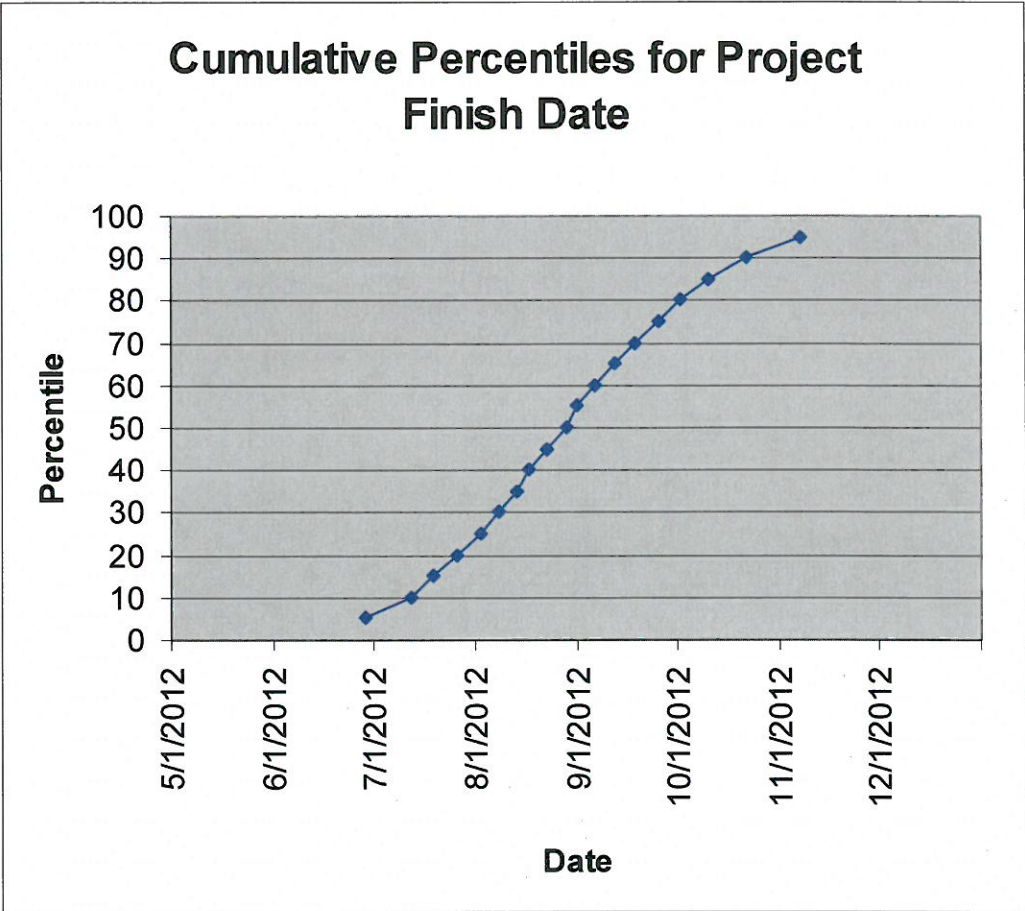


Table 7 – Cumulative percentiles for Project Finish Date

Percentile	Value
5%	6/28/12
10%	7/12/12
15%	7/19/12
20%	7/26/12
25%	8/2/12
30%	8/8/12
35%	8/13/12
40%	8/17/12
45%	8/22/12
50%	8/28/12
55%	8/31/12
60%	9/6/12
65%	9/12/12
70%	9/18/12
75%	9/25/12
80%	10/2/12
85%	10/10/12
90%	10/22/12
95%	11/7/12

Potential Critical Activities

Because of the ranging process, there is a possibility that the critical path changes during various simulation iterations.

Table 8 below shows activity *criticality indices*. Criticality index is the likelihood that an activity may end up on the critical path. A higher index, is an indication that a certain activity is more likely to be critical during the project execution. Only activities with criticality indices of larger than 5% are reported in Table 8.

Table 8 – Activity Criticality Indices

Activity Description	Duration (working days)	Criticality Index
Manufacture and Deliver TBMs	252 days	30.46%
Assemble TBM A	60 days	68.59%
Assemble TBM B	40 days	65.41%
TBM 1B EB Lower from Assembly to 38 th	149 days	65.41%

D&B Exc. GCT 5 WYE EB & Starter Tnl (10,407 bcy)	114 days	65.41%
Backup & Re-Assemble TBM B at 59th St	20 days	65.41%
TBM 2B - #15 EB WYE to Upper 38th (5,241 TF)	112 days	65.41%
Backup & Re-Assemble TBM B at Lower EB#10 WYE	35 days	61.25%
TBM 3B Lower EB from #10 WYE to 43rd (1,582 TF)	34 days	61.25%
Backup & Re-Assemble TBM B at Upper EB#10 WYE	35 days	65.36%
TBM 4B EB Upper from #10 WYE to 43rd (1,407 TF)	30 days	65.36%
Backup & Disassemble TBM B at Upper EB 43th St	30 days	65.36%
CM012 - Caverns Concrete Complete	0 days	26.67%
**** CM012 Cavern Excavation Complete ****	0 days	42.02%
Access to Launch Area for Tunnel Structure Const	0 days	41.93%
Coordinate LL Trackways Access w/CS078	0 days	42.98%
Install Trackwork - Lower 38th St to GCT 2	60 days	42.98%
Manhattan Local System Testing	88 days	69.83%
SPE Manhattan Facilities - Plaza to No. Cavern	200 days	26.38%
Manhattan Wayside Signal Installations	366 days	42.98%
Tracks B/C Approach & Pit Roof Structure	220 days	21.08%
Outfit Ex. 63rd St. Tnl & Assembly Chamber	266 days	34.48%
East Caverns - Excavation (Includes Top Arch)	272 days	65.36%
East Caverns – Concrete	305 days	25.58%
Complete Lower Level Tunnel/Structure	132 days	42.02%
Amtrak Harold F/A Stage 1 Construction	664 days	17.74%
Amtrak Harold F/A Stage 2 Construction	367 days	22.05%
Amtrak Harold F/A Stage 3 Construction	374 days	22.05%
Amtrak Harold F/A Stage 4 Construction	357 days	22.08%
LIRR Harold F/A Stage 1 Construction	672 days	5.80%
LIRR Harold F/A Stage 2 Construction	367 days	6.10%
LIRR Harold F/A Stage 3 Construction	374 days	6.10%
LIRR Harold F/A Stage 4 Construction	357 days	6.10%
Projectwide Start-up, Testing & Commissioning	129 days	92.78%
Begin LIRR Revenue Service to GCT	0 days	100.00%

The @Risk software also provides a sensitivity analysis report for the schedule that can help identify problem areas and bottlenecks. The results of the sensitivity analysis are reported in Table 9 below. In this table, 16 activities are ranked according to their impact on the value of the model output. The model output in our case was defined as the finish time for the “Begin LIRR Revenue Service to GCT.” This means that these 16 activities had the most impact in determining the project finish time. All of these activities are also reported in Table 8 and belong to activities with relatively high criticality indices.

Table 9 – Sensitivity Analysis Results

Rank	Name
#1	East Caverns - Excavation (Includes Top Arch)/Duration (Dist.58) / Task 73
#2	Projectwide Start-up, Testing & Commissioning/Duration (Dist.127) / Task 148
#3	Complete Lower Level Tunnel/Structure/Duration (Dist.108) / Task 126
#4	Manhattan Wayside Signal Installations/Duration (Dist.38) / Task 51
#5	East Caverns - Concrete/Duration (Dist.59) / Task 74
#6	D&B Exc. GCT 5 WYE EB & Starter Tnl (10,407 bcy)/Duration (Dist.14) / Task 14
#7	TBM 1B EB Lower from Assembly to 38th/Duration (Dist.13) / Task 13
#8	TBM 4B EB Upper from #10 WYE to 43rd (1,407 TF)/Duration (Dist.20) / Task 20
#9	TBM 3B Lower EB from #10 WYE to 43rd (1,582 TF)/Duration (Dist.18) / Task 18
#10	TBM 2B - #15 EB WYE to Upper 38th (5,241 TF)/Duration (Dist.16) / Task 16
#11	SPE Manhattan Facilities - Plaza to No. Cavern/Duration (Dist.36) / Task 49
#12	Amtrak Harold F/A Stage 3 Construction/Duration (Dist.117) / Task 137
#13	Manufacture and Deliver TBMs/Duration (Dist.1) / Task 1
#14	Outfit Ex. 63rd St. Tnl & Assembly Chamber/Duration (Dist.57) / Task 72
#15	Manhattan Local System Testing/Duration (Dist.35) / Task 48
#16	Amtrak Harold F/A Stage 2 Construction/Duration (Dist.116) / Task 136

SUBTASK 22D – RISK MITIGATION PLAN REVIEW AND RECOMMENDATIONS

BACKGROUND

A Risk Mitigation workshop was held on October 14, 2004. Members of the MTA project team, the FTA and the PMOC were in attendance. The purpose of the workshop was to review the top 10 risk items on the project and determine how these risks could be mitigated if a plan were implemented. The strategies were noted, and the revised ranges for the potential costs were again run through a Monte Carlo simulation to determine the new confidence level for the project achieving the project budget.

MITIGATION STRATEGIES, PROBABILITIES, MEASUREMENT

The top ten risks were identified through the original simulation, and potential mitigation measures were discussed in the workshop. Each of the items is discussed below.

Cost Escalation (Project Wide) - The escalation was run at 3.5 percent, a conservative number that is currently being used by the FTA. There are really no mitigation strategies that can be used to mitigate escalation, but a project budget that includes escalation assumptions is the best strategy, and was employed by the ESA project team.

Unit Cost Increase for Rolling Stock (Project Wide) – Risk #5-000-04 - ESA reported that they will not pursue purchasing the rolling stock through their current contract.

It was noted that all of the new riders projected to use the ESA service will not use the new facilities immediately the system opens. ESA has estimated that 80% of the forecast new riders will use the service in 2012. The 100% level of new ridership is expected by 2020. Accordingly, only 140 to 146 new cars are needed by 2012, when construction will be completed. 180 new cars are needed by 2020.

As a mitigation measure of the Rolling Stock risk, ESA proposed purchasing 140 to 146 cars through the capital program and then procuring additional cars after 2012 through other options as demand warranted. The other options would be outside the ESA budget. The procurement contract would be structured accordingly.

The ESA advised that the Rolling Stock budget remains at \$460M and a projected purchasing price increase stays within budget with the reduction of total cars purchased. The ESA sees no risk in exceeding the budget with this mitigation measure. No other mitigation measures are being considered at this time related to Rolling Stock. After much discussion, ESA agreed to look at other options such as a reduction in the price of the cars.

The PMOC noted that reducing the number of cars can be construed as a change of scope against the FEIS, and would need approval from the FTA. The PMOC noted that cutting scope is not considered an acceptable mitigation measure.

Building Owner Opposition to Property Taking (CM015) – Risk #1-015-03 - This risk relates to a property at 48th Street. \$10M will be added to the base cost of CM015 for a revised entrance design. No mitigation will be required.

OCIP – Claims Against Deductibles (Project Wide) – Risk #5-000-05 - The ESA reported that it has no liabilities except Builder's Risk. The MTA stated that the history of loss in the New York City area related to Builder's Risk is very low. The ESA believes that the PMOC's estimate of ten events seems high. PMOC reviewed the issue and kept the levels as in the original mitigation run.

MTACC is self-insured with a \$100M Captive Railroad Protective Policy (no deductible) and individual projects will fund the captive. The \$259M OCIP budget includes all payments to the captive. ESA believes the captive may be in a position to pay for the Builder's Risk deductibles as well.

Change in Alignment due to Amtrak (Harold) – Risk #3-000-14 - The ESA reported that Amtrak has a pretty good feel for the alignment. Specific agreements to areas are required.

The ESA expects a submission from Amtrak. A mitigation measure will be to tweak Amtrak's submission. ESA considers that Amtrak has been easy to work with on past alignment issues.

Lack of Competition (CS079) – Risk #4-079-05 – ESA noted that the CS079 contract is expected to be higher than the estimated base cost with a range of +15%, -5%. ESA said this lack of competition risk is covered under this range and thus believes this risk is double dipping. Consequently, the PMOC agreed to remove this from the risk analysis.

Lack of Amtrak Resources (Harold) – Risk #3-000-07 – The ESA advised that if lack of Amtrak resources becomes a problem, it may request assistance from consultants. Mitigation of this risk would be to hire consultants or provide ESA staffing for assistance.

The ESA will request that Amtrak dedicate a construction gang to the project for the required force-account work. The ESA foresees Amtrak asking for a third party contractor to construct foundations and catenary poles. There doesn't appear to be a union problem since it gives workers more maintenance work when completed.

Differing Site Condition (CM009) – Risk #1-009-01 - Contract CM009 has been bid. The ESA stated that after the first TBM tunnel has been driven, its staff will meet with the contractor to discuss possible adjustments to means and methods. This is the mitigation, which could include modifying the TBM or additional grouting. Water is the primary concern.

Increased Blasting Restrictions due to MNR Concerns (CM012) – Risk #1-012-01 - It was agreed that experience with Contract CM009 will provide an opportunity to know what to expect with the rock to be encountered. The CM012 specifications could be revised accordingly, mitigating the risk.

TBM Unable to Mine Ground to Meet Schedule (CQ031) – Risk #2-031-03 – The ESA noted that there is a very narrow band of mixed face material within the CQ031 area. As a mitigation measure, a more definitive rock mapping of the area is to be performed, with an accompanying descriptive specification.

Steel Price Increase (Project Wide) – Risk #5-000-01 - With the deletion of the CS079 Lack of Competition Risk (#4-079-05), the 11th ranked risk was included in the top ten. This was the steel price increase – Risk #5-000-01.

MTA noted that there is a steel escalation clause in the contracts. No mitigation measures are required,

RESULTS OF THE RISK MITIGATION WORKSHOP

Based on the outcome of the risk mitigation workshop on October 14, 2004, the following changes were made in the risk analysis model (spreadsheet).

Unit cost increase for rolling stock - This risk item was reduced by a change of scope. The MTA decided to calculate the risk based on 146 cars instead of the 180 cars that were considered in the original project scope. Based on this scenario, the potential for cost overrun was reduced.

OCIP – Claims against deductible – The ESA staff referred to the insurance policy documents and re-assessed the previous risk costs estimated by the PMOC. This resulted in much smaller risk costs. The revised risk cost limits replaced the original limits in the risk model. So this is a case of correcting and replacing the previous risk item and not strictly a mitigation measure.

Other mitigation measures – Various mitigation measures were suggested for other most critical risk factors as discussed in the risk mitigation workshop. For modeling purposes the following concept was used:

Step 1 – Does the risk occur? The probability of occurrence of each risk was used to decide if a certain risk will occur or not. If the risk does not occur, then there is no need for mitigation.

Step 2 – If the risk occurs, is mitigation successful? The probability of success of mitigation measures was elicited from the ESA staff and augmented with PMOC views. If mitigation is successful (say with probability 75%), then a mitigated cost of risk is used in the simulation analysis; if mitigation is not successful (say with probability 25%), then the unmitigated risk cost is used in the simulation analysis.

RESULTS OF THE MITIGATION ANALYSIS

The result of the simulation (for 10,000 iterations) is given in Table 10. Figure 6 gives the risk profiles for pre-mitigation and post-mitigation analyses. Based on our analysis, the probability of cost overrun after mitigation is reduced from 22% to 17%, *i.e.*, there is an 83% chance that the \$6.3 billion budget is sufficient for the execution of the ESA Project.

TABLE 10 – Cumulative Distribution of total costs after mitigation

Cumulative probability	Total costs (\$)	Cumulative probability	Total costs (\$)
5%	4.93E+09	55.0%	5.82E+09
10.0%	5.09E+09	60.0%	5.89E+09
15.0%	5.21E+09	65.0%	5.97E+09
20.0%	5.30E+09	70.0%	6.05E+09
25.0%	5.38E+09	75.0%	6.15E+09
30.0%	5.46E+09	80.0%	6.25E+09
35.0%	5.53E+09	85.0%	6.38E+09
40.0%	5.60E+09	90.0%	6.54E+09
45.0%	5.68E+09	95.0%	6.79E+09

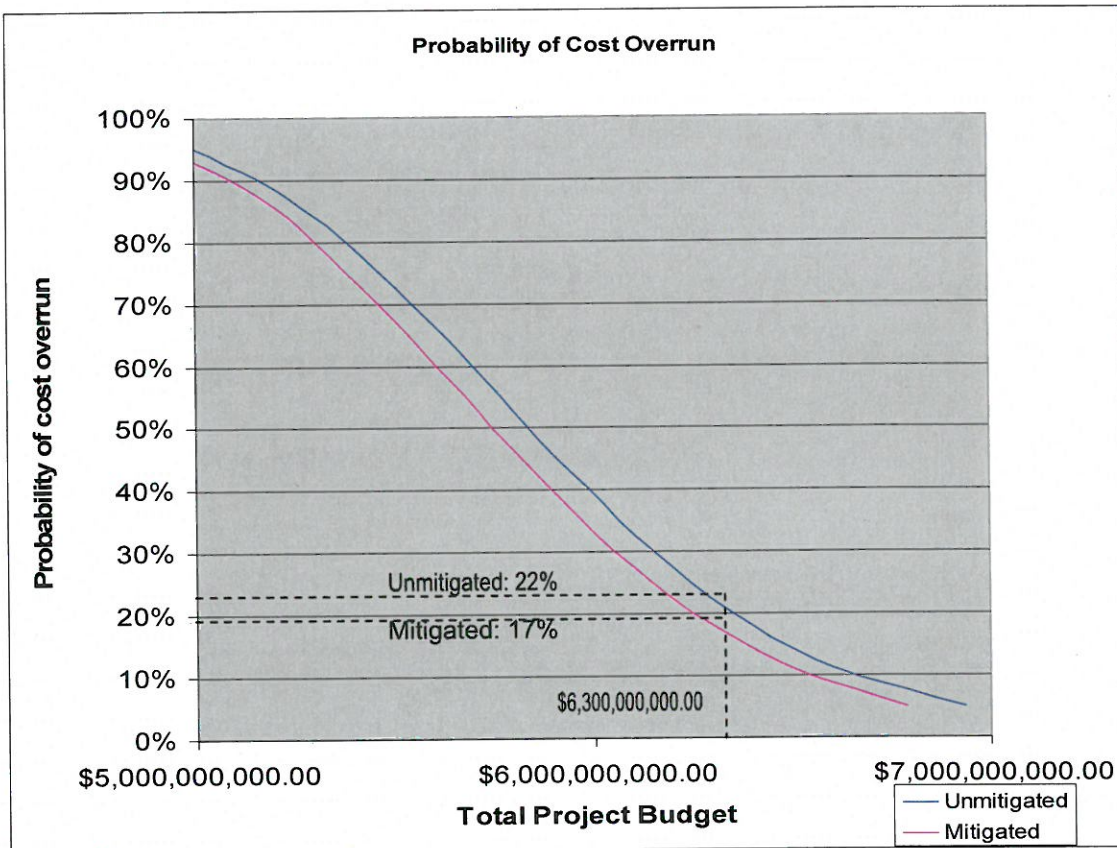


FIGURE 6 – Risk Profiles before and after mitigation

CONCLUSIONS

Based on the analysis performed, and with the assumptions that are outlined in this report, the PMOC makes the following conclusions:

- Based upon its sampling of the grantee data and corresponding engineering analysis, it is the PMOC's opinion that the project scope as outlined in the Contract Packaging Plan for the East Side Access Program is consistent with the Record of Decision, sufficiently complete to support the level and quality of revenue service typically offered by the grantee, constructible and cost-effective.
- The project is in various phases of design and design development. Some contracts have been completed, some are in the bidding phase, and some contracts are still at the fifteen percent design stage. Based upon the contracts that have been bid and reviewed by the PMOC, the contract plans are adequate in terms of content, presentation, clarity, cross referencing and detail. In its Risk Analysis, the PMOC took into account areas where there are possible interface issues. The roles and responsibilities of contractors versus those of the authority (staff and any consultant support) are well defined. The grantee has chosen an appropriate level of technology that is consistently applied in systems descriptions and designs.
- Based upon its sampling of the grantee data and corresponding engineering analysis, it is the PMOC's opinion that the Baseline Cost Estimate (or Project Cost Estimate as appropriate) is mechanically correct and complete, consistent with the project scope adopted in the Record of Decision (amended as appropriate) and free of any material inaccuracies or incomplete data. It is also consistent with relevant, identifiable industry or engineering practices, uniformly applied by the grantee's cost estimators and consistent in its method of calculation.
- The PMOC's risk analysis determined that there is a 78% probability that the project would beat the budget, based on the risks that were identified by the ESA. As stated in the assumptions, the PMOC used the risks developed by the project team in the analysis. The PMOC believes that 78% is acceptable based on the length, size and scope of the project.
- The PMOC's schedule simulation determined that there is an 80% probability that the finish date will be on or before October 2, 2012. PMOC believes this is acceptable based on a project duration of 8 years.
- A Mitigation Workshop was held, the top 10 risks were evaluated and a determination made on the ability to mitigate those risks. Based on the results, the confidence level rose to 83% that the project would be completed within the project budget.