

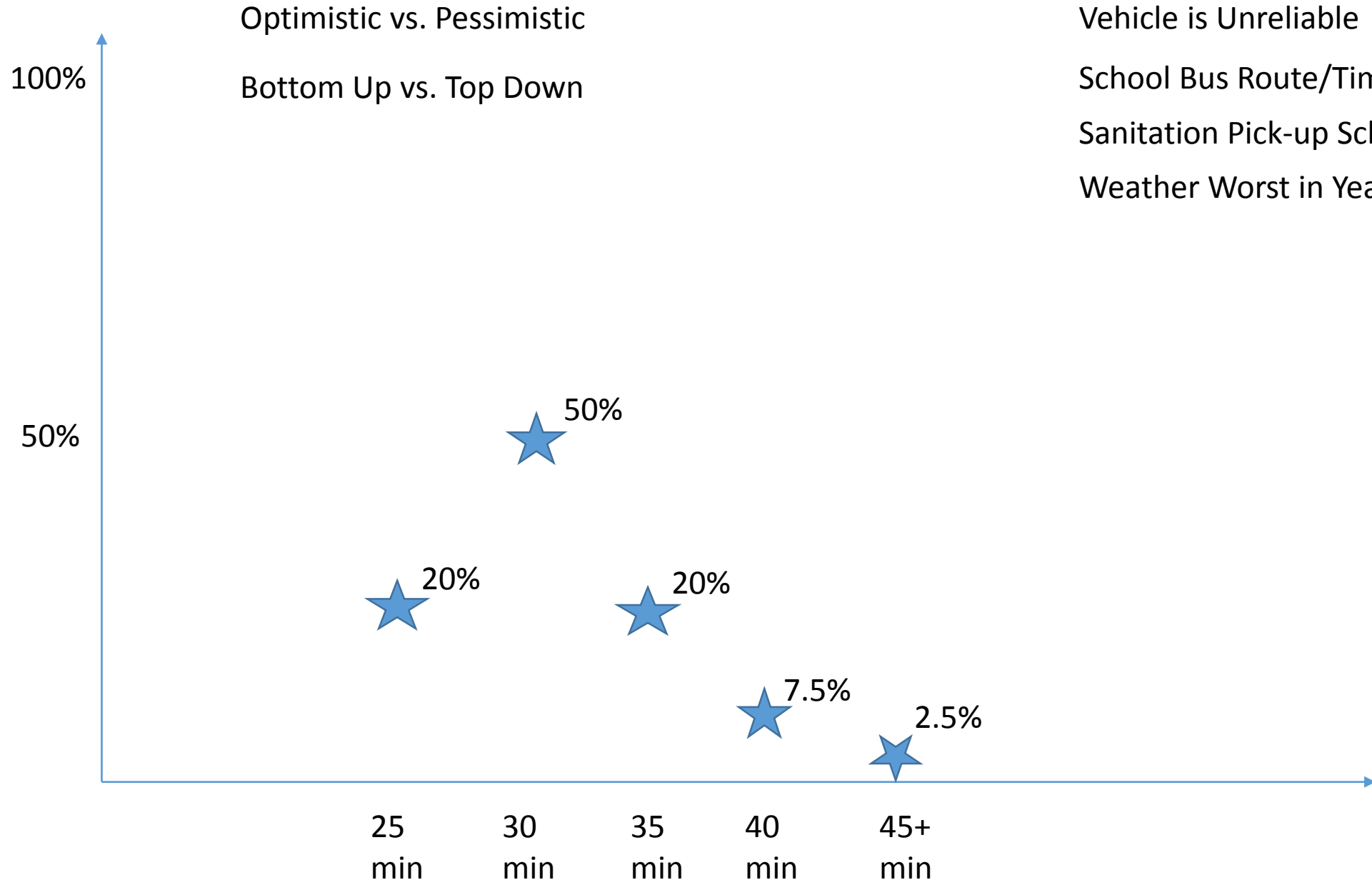
Optimizing Risk Assessments of Capital Projects

Michael P. Wetherell, P.E.

Senior Vice President – McKissack & McKissack

Agenda

- Basics
- Elements of a Risk Assessment
- Optimizing the Risk Assessment
 - Risk Based Project Oversight
 - Management Monitoring of Risk



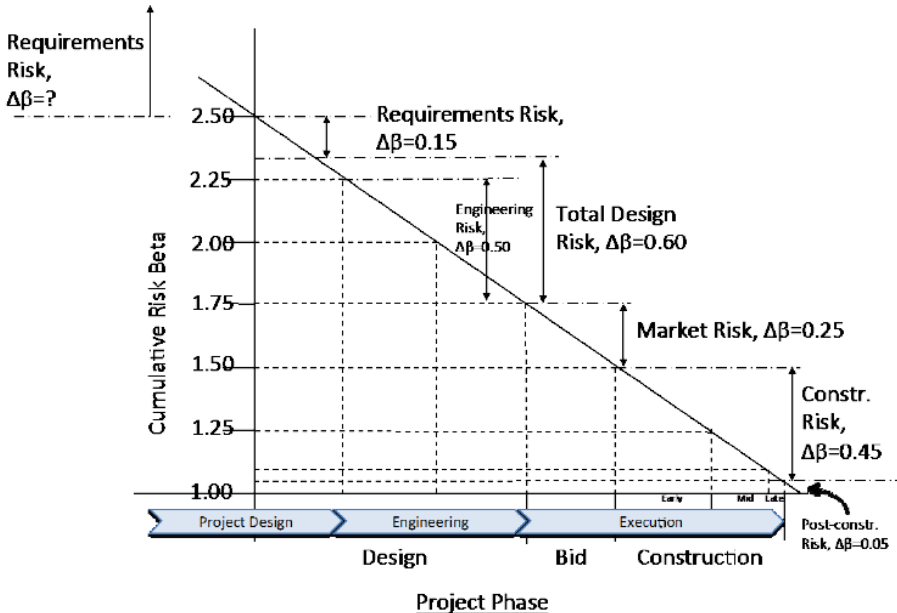
Optimistic vs. Pessimistic
Bottom Up vs. Top Down

Vehicle is Unreliable
School Bus Route/Time Change
Sanitation Pick-up Schedule Modified
Weather Worst in Years

Risk Assessment

- Data
- Bias
- Bottom-up vs Top Down

Lp.	The main of risks	Owner of risk	Reason/cause	Effect	Risk assessment			Risk response strategy	Cost of strategy
					Probability	Impact	Level of risk		
Designing risk									
1	Lack of acceptance by Investor of design proposals	Investor	Delays in approval	Increase in costs due to the suspension of work of the design team	5-40%	50thous.-500thous.	Low	Market observation, alternative designing solutions	0
2	Delays and difficulties in obtaining opinions and permits	Investor	Delay of designing work, unknown scope of design	Disturbed designing process	5-40%	500thous.-2millions	Medium	Earlier diagnosis of the situation in local authorities offices, organization of meetings preceding designing process	50thous.
3	Conflict among designing team members	Designer office	Insufficient flow of information among team members	Disturbed designing process	0-5%	50thous.-500thous.	Low	Response of a team leader to all form of conflicts - mediation in a team	15thous.
4	Too optimistic assessment of employee workload	Designer office	Approval of unrealistic deadlines for individual work	Delay of designing work	5-40%	50thous.-500thous.	Low	Proposing for employees to work overtime or ordering of part of work to another designing team	120thous.
5	Incorrect information from investor/lack of clear guidelines	Investor	Design may be issued with duplicate error or detected error can generate timing constrains	Verification of errors will increase costs and increase time due to the development of the next revision of design	40-70%	2-5 millions	High	Application to investor for extension of time to complete a design due to additional circumstances	20thous.
6	Staff do not have sufficient knowledge about the subject of design	Designer office	Errors in design	Verification of errors will increase time due to the repeated checks of designing work	5-40%	2-5 millions	Medium	Designing team leader strengthens control over work, providing for employees consultation with an expert	65thous.
Time risk									
7	Acceptance of unrealistic deadlines in contract	Designer office	Faulty contractual provisions	Deterioration of design quality of failure to meet the deadline	40-70%	2-5 millions	High	Employment of new employees or ordering part of work to another party during a contract	105thous.
Budget risk									
8	Underestimation of design budget	Investor	Budget may not be sufficient to carry out designing tasks	Deterioration of design quality	40-70%	2-5 millions	High	Limiting scope of design to necessary minimum	40thous.

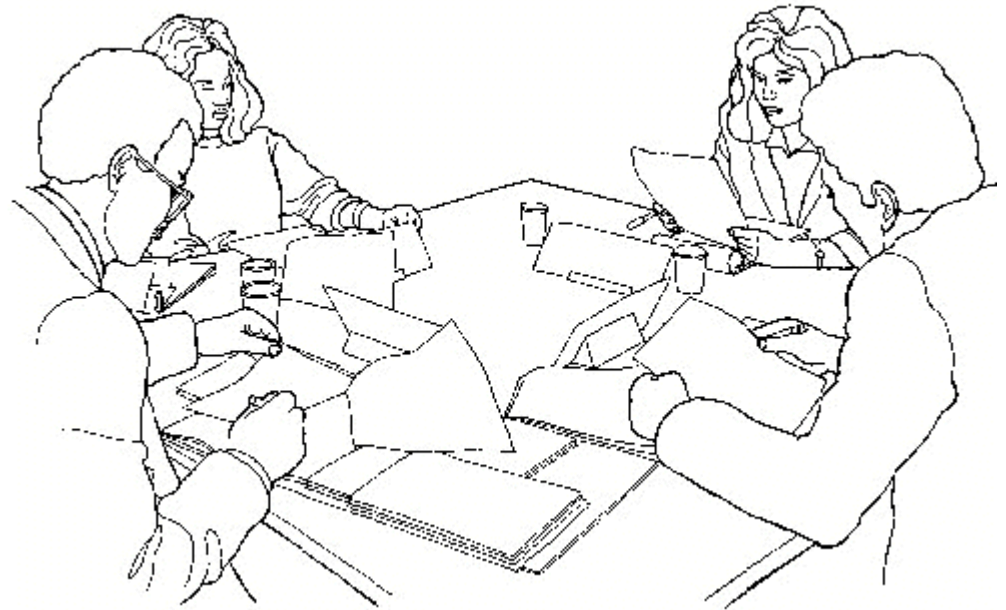


	Unit Pricing		CER	Lump Sum Allowance	Total	Contingency	Escalation
	Design Quantity	Estimated Quantity					
10. Gullway & Track Elements	\$81,573,384	\$397,138,488	\$744,181,418	\$48,185,821	\$1,280,948,097	\$183,179,000	\$120,732,087
design documents - 70%	\$693,887,874	\$307,498,502	\$600,405,663	\$33,730,074			
design report - 20%	\$178,275,074	\$86,435,260	\$148,830,284	\$8,837,184			
specifications - 10%	\$69,132,698	\$38,712,848	\$74,415,142	\$4,818,562			
general conditions							
20. Stations, Stops, Terminals	\$916,881,443	\$176,236,481	\$424,899,871	\$28,446,377	\$1,136,868,871	\$108,478,000	\$80,016,871
design documents - 70%	\$367,484,350	\$118,187,338	\$287,269,700	\$20,263,364			
design report - 20%	\$153,267,433	\$51,098,144	\$127,469,871	\$8,884,513			
specifications - 10%							
general conditions							
30. Support Facilities: Yards, Shops, Admin.	\$68,919,380	\$187,838,828	\$128,116,434	\$8,720,686	\$364,596,288	\$30,880,000	\$11,672,248
design documents - 40%	\$41,267,565	\$92,700,111	\$62,237,000	\$4,233,000			
design report - 25%	\$27,587,704	\$55,135,408	\$37,848,174	\$2,468,234			
specifications - 10%							
general conditions							
40. Slewwork & Special Conditions	\$128,028,809	\$28,608,706	\$97,400,000	\$8,222,800	\$286,887,200	\$30,225,000	\$15,814,000
design documents - 75%	\$96,991,395	\$19,256,295	\$75,745,000	\$4,867,100			
design report - 25%	\$32,287,125	\$6,451,425	\$24,250,000	\$1,855,700			
specifications - 10%							
general conditions							
50. Systems	\$138,748,803	\$271,487,206	\$284,000,000	\$17,487,200	\$876,743,200	\$78,130,000	\$78,087,000
design documents - 40%	\$54,299,483	\$106,598,966	\$101,800,000	\$8,486,360			
design report - 50%	\$67,874,300	\$135,746,600	\$127,000,000	\$8,748,800			
specifications - 10%	\$13,574,860	\$27,149,720	\$25,400,000	\$1,748,720			
general conditions							
60. ROW, Land, Existing Improvements	\$74,284,889	\$36,108,400	\$30,108,400	\$16,983,200	\$186,832,000	\$0	\$4,368,000
design documents - 40%	\$18,018,500	\$7,236,600	\$7,236,600	\$3,763,300			
design report - 50%	\$37,833,000	\$18,053,000	\$18,053,000	\$7,855,800			
specifications - 25%	\$16,018,500	\$7,236,600	\$7,236,600	\$3,763,300			
general conditions							
70. Vehicles	\$481,821,473	\$36,108,400	\$79,880,280	\$0	\$631,201,733	\$40,828,000	\$78,282,000
design documents - 0%							
design report - 100%	\$481,821,473		\$79,880,280				
specifications - 0%							
general conditions							
80. Professional Services	\$98,074,260	\$82,111,206	\$248,282,200	\$87,348,700	\$1,236,914,200	\$3,844,000	\$47,828,000
design documents - 50%	\$184,037,100	\$778,058,680	\$122,689,400	\$38,873,850			
design report - 40%	\$147,259,880	\$320,844,800	\$88,134,120	\$24,555,200			
specifications - 10%	\$36,807,420	\$55,211,130	\$24,536,200	\$6,134,870			
Total	\$2,636,828,983	\$1,454,718,688	\$2,604,438,023	\$186,978,184	\$8,536,787,200	\$490,541,000	\$428,048,287

Figure 1 – SCC 10-50 Beta Risk Factors by Level of Development

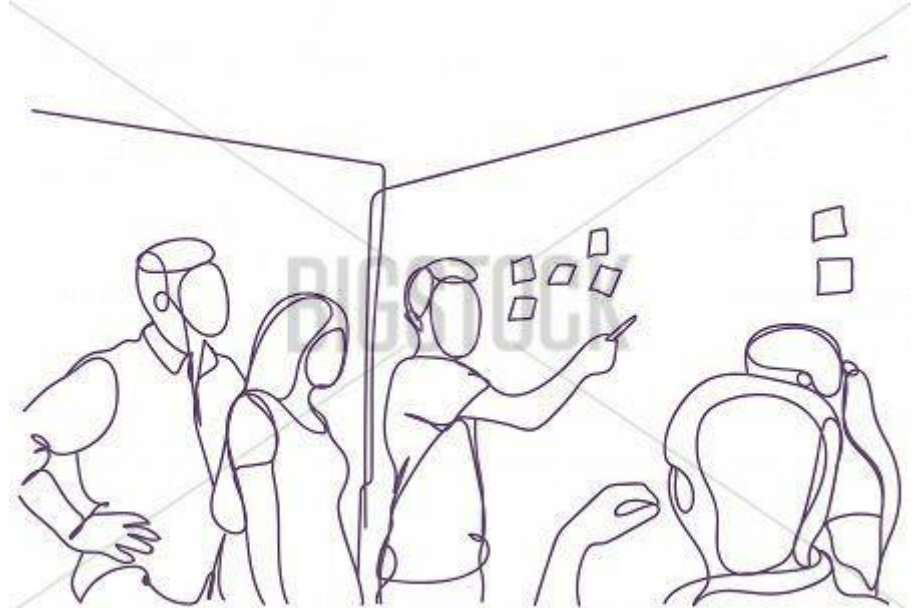
Performing the Risk Assessment

- Engagement of Stakeholders
- Estimation and Scheduling
- Risk Allocation
- Delivery Method
- Contingency
- Transparency
- Prior knowledge of risk factors
- Proper assumptions regarding risk mitigation
- Sessions
 - Project Team
 - Stakeholders
 - Ground Rules



Risk Assessment Essentials

- Accurate Basis for Analysis
 - Estimate errors
 - Scheduling errors
 - Project Team experience, Resources, Access to timely, accurate decisions
 - Sufficient Backing from Management
- Realistic Acknowledgement of Project Risks
 - BIAS
 - Actual links between contracts assumptions are Correct
 - Look for individual areas where the project element of risk is understated
 - Whatever can go wrong, can go wrong
 - Un-mitigated
 - Mitigated
- DATA
 - Unbiased and knowledgeable participants
 - Data accumulated over several similar activities
- Application of Data
 - Top-down – SCC code progress
 - Bottom up – assign experiential values to actual activities



Risk Based Construction Oversight

- Risk Based – Risk assessment results are integrated throughout the project planning and delivery process
- Data Driven – More informed decisions based on objective data
- Proactive – Less surprises, deals with threats, takes advantage of opportunities
- Consistent from Project to Project – Actions based on a consistent approach
- Value-added – Actions are taken with a primary objective of improving project outcome, can streamline decision making with limited resources

Risk Assessment Workshop

- Define project Milestones
 - Milestones will be used in the Risk Model
 - Milestones will be included in the contract General Requirements and tracked as the project progresses
- Develop a Flow Chart based on project Milestones.
- A Value Engineering study can also be included as part of the Risk Management process.

Risk Identification

- Identify as many risks as possible that may affect project objectives.
Sources:
 - The project team
 - Other stakeholders, user groups, and/or subject matter experts as appropriate
 - Lessons learned (risk database, institutional experience)
- Define potential Impacts to cost and schedule for each risk and the probability of occurrence.
- Discuss and record if each risk event can be avoided, transferred, mitigated or accepted.
- Discuss and record potential opportunities

Risk Report and Risk Register

- The Risk Register will contain the following information:
- Risk number for tracking purposes
- Risk Name and detailed description
- Risk Codes that define the type of risk and the type of work
 - Codes are based on FTA standards
 - Codes can incorporate Change Order
- Potential cost impact, potential schedule impact, and probability of occurrence
- Schedule milestones that may be impacted
- Potential mitigation responses

Risk Monitoring and Risk Response

- The Risk Register is uploaded into the Risk Database
- The Risk Log is generated from the database and updated monthly
- Mitigation efforts and their results are recorded in the Risk Database
- Risks are closed as work progresses, actual impacts are recorded
- Project Closeout
 - Remaining open risks are reviewed with the project team:
 - Risks that were not realized are closed
 - If risks did occur, actual impacts are recorded
 - Analysis of the Change Order log and final schedule provide accurate impact data
 - The resulting data is stored in the Risk Database and can be mined for future Lessons Learned

Risk Database

- Recognition of Potential/ Active Risks and Opportunities
- Decision-making Tool
- Log of Project Management Decisions
- Accountability for Project Activities
- Lessons Learned
- Transparency

Ref No: 12-345		Top Cost and Schedule Risk Log			September 2017	
XYZ Station Reconstruction						
Agency: XYZ	Agency PM: XYZ	EAC at Award: \$158.4 M	SC at Award: Aug 2018	Last Review: May 2017		
Contract: XYZ	PM: XYZ	Current EAC: \$175.0 M	Current SC: Dec 2018	RA Date: Jun 2015		
45% Complete	Designer: XYZ	Project On Budget: YES	Project On Schedule: NO	NTP Date: Apr 2015		
	Contractor: XYZ			Last Update:		

Data Date: 00/00/2017 [DRAFT]

Risk No.	Risk Description	PROB	COST	SCHED	Risk Status Update	Milestone Desc. & Date	Agency or RA Mitigation	Comments
R - REQUIREMENTS								
R-45.1 Scope Change by Agency	Substantial completion is dependent on a number of significant change orders, in particular the XYZ Street north entrance ("Bulletin 3"), and updated communications and electrical changes ("Bulletin 2"). These unresolved scope additions will impact the budget and the schedule.	V. High > 85%	Low 1 - 4%	V. High > 90d	All critical Bulletin 2 change orders have been negotiated. RFPs for Bulletin 3 work have been issued. The Agency has agreed to review critical submittals within 7 days.	Issue AWOs for Bulletin #3 Change Orders.	The project team does not anticipate any major scope changes past Bulletin #3.	The project budget includes set aside contingencies for the estimated cost of the work included in Bulletin 2 and 3. There remains a significant cost and schedule risk due to anticipated impacts related to these changes.
R-91 Contingency, AFI	Anticipated impact costs associated with change orders have not been negotiated and will not be supported by the current project budget.	V. High > 85%	Med 4 - 7%	Opportunity	To date, negotiations on Bulletin 2 work do not include anticipated impact costs. There exists a potential to negotiate an accelerated schedule during negotiations for impact costs.	N/A	XYZ has requested a budget increase for the ABC Street reconstruction in light of the current shortfall. Pending <i>rushtadnroak outstard</i> will add an additional \$23.4M for risk reserve. Construction of the Street stairs and elevator is contingent on XYZ construction of foundations. XYZ has prepared and issued RFPs and provided takeoffs to the contractor so that these changes can be negotiated in the next 60 days.	In the XYZ's opinion, the requested budget increase should be sufficient to support the project to completion.
D - DESIGN AND MANAGEMENT								
D-93 AWO Approval	Issues related to Bulletin 3 change order negotiation and approvals.	High 60 - 85%	Med 4 - 7%	Med 31 - 60d	The project team recently issued RFPs for design changes to the XYZ Street entrance at the north end of the platform ("Bulletin 3"). Before the work can begin, the scope must be negotiated with the contractor and the Port Authority must complete structural work (this work is addressed in a separate risk).	Begin construction of the Vesey Street entrance.		XYZ must finalize outstanding change orders as this continues to impose budget and schedule uncertainty to the project.
C - CONSTRUCTION								
C-3 Contractor Interface	A number of construction and system interfacing issues between XYZ infrastructure and XYZ structure has recently become more impactful to the project.	Med 40 - 60%	V. Low < 1%	V. Low < 10d	Interface issues include areas where XYZ has installed some utilities and conduit within XYZ allocated spaces, which may interfere with the construction of station rooms and systems installation. Recently, the XYZ has requested that they relocate the station's smoke exhaust ductwork in certain locations (at no cost to the XYZ). The project team reviewed the XYZ proposal and found that it will also require moving other XYZ utilities. This work is to be done by the xyz but poses a risk to the completion of station walls and finishes.	Station completion	The project team notifies XYZ of interface issues as they occur. As a result, XYZ response to interface issues is improving and they have committed an on call contract to correct interface issues as they arise. XYZ continues to work with XYZ to resolve outstanding issues.	The XYZ has observed improved communication between XYZ, XYZ and other XYZ stakeholders in recent months which has minimized the impacts of interface issues.
C-18 Long Lead Items	Completion of communication systems and electrical work is on the critical path, and requires procuring long lead items.	Med 40 - 60%	Med 4 - 7%	High 61 - 90d	The contractor has been given directive to start work on all critical communication and electrical work. AWOs must be issued before contractor will begin shop drawings.	CRITICAL	Focus at this time is ensuring that the submittals are expedited so that work can proceed unimpeded. To achieve this, the project team is pre-reviewing critical submittals with XYZ.	The XYZ will continue to monitor the submission and approval process of long lead items and critical submittals.
C-26 Electric Supply	New property line boxes (PLBs) and conduit paths for electric service (both permanent and reserve) cannot be installed as designed due to utility congestion from XYZ to XYZ streets.	V. Low < 15%	V. Low < 1%	V. Low < 10d	Installation of the reserve PLB is completed. Installation of the PLB for normal (permanent) is occurring in conjunction with pulling cable during the last week in August. The risk has shifted to Con Ed's ability to energize the connections prior to the start of swinggear testing in March 2018.	03/19/2018 Connection to permanent power supply	XYZ has provided Con Edison with all necessary items for conduit installation from the PLB to the vault. Con Edison has provided a new cost estimate and is in process of scheduling the conduit installation. In the event that Con Ed does not energize the connections prior to swinggear testing, mitigation will require temporary generators.	The potential impacts of this issue have been reduced. The XYZ will continue to monitor until the connection to permanent power occurs.
C-29 Utility Agreements	Current design of the new station assumes that chilled water will be supplied by XYZ. An agreement between XYZ and XYZ has not been finalized, and the status of the connection is unknown.	Med 40 - 60%	V. Low < 1%	V. Low < 10d	Shop drawings for the chilled water connection are underway.	09/14/2017 INSTALL AC-1 - NORTH MEZZ COMM RM M2D12	In the past month, the project team met with XYZ and the contractor at the site and walked through the areas affected by the chilled water connection. The contractor is proceeding with shop drawings based on the results of this meeting. Connections may be made prior to the formal agreement.	The xyz will continue to monitor this schedule item.

DRAFT/CONFIDENTIAL: This working paper is to be used for internal deliberative purposes only.

Risk Management – Management Monitoring of Projects

- Tracking Progress/ Results
 - Regular Reviews
 - Database
 - Reports
- Project Team Objectives
 - Attack Risks
 - Enable Opportunities
 - Anticipate Obstacles
- Design/ engineering review support
- Community interaction
- Support funding
- Support for labor issues
- Operating priority
- Allocation of resources to the project team
- Enforcement support for project team
- Interaction of project team with contractor
- Support for contractor – work trains, site availability
- Agency work rules

Keys To Success



- Management Support – Understanding the Issues
- Project Management – Implementation and Enforcement
- Organizational Support – Operations, Maintenance, Acceptance