

Connecting people. Connecting communities.

Risk Mitigation Meeting Minutes #48

DATE: August 20, 2013

MEETING DATE: August 13, 2013

LOCATION: 821 Howard Street, 2nd Floor – Main Conference Room

TIME: 2:00pm

ATTENDEES: John Funghi, Albert Hoe, Eric Stassevitch, Alex Clifford, Vivian Chow,

Beverly Ward, Roger Nguyen, Luis Zurinaga. Brad Lebovitz

COPIES TO: Attendees:, Richard Redmond, Mark Benson, Jane Wang, Mark Latch, Sanford Pong,

Aileen Read, Chuck Morganson, James Sampson, David Kuehn

File: M544.1.5.0820

REFERENCE Project No. M544.1, Contract No. 149 Task 1-4.01

Program/Construction Management

SUBJECT: Risk Management - Risk Mitigation Meeting

Risk Mitigation Report No. 48

RECORD OF MEETING

ITEM#	DISCUSSION	ACTION BY DUE DATE
1-	Proposed revisions to Schedule Contingency Management currently under review by the FTA, requires additional supporting risk analysis to demonstrate the confidence in the proposed changes to the schedule contingency drawdown curve. The Program's Risk profile changed in September 2012 due to changes in the Program's contract delivery strategy. The Risk Manager is currently conducting an in house 2013 Risk Refresh to further analyze and document the impact of the new risk profile on the cost and schedule of the Program. One element of the Risk Refresh is the Schedule Assessment; to be discussed in detail at today's meeting.	
	The Risk Refresh contains a comprehensive review of all aspects of the Program, and the focus of today's meeting is only on the Schedule Assessment and Risk Modeling performed on the current Program Master Schedule. The Risk Manager presented as a point of reference the schedule contingency drawdown curve developed and maintained since March 2009 and explained that the remaining agreed to FTA hold points are based on Program construction costs at 20%, 50%, 75% and 90% completion.	
	The schedule assessment utilized the Schedule Risk Analysis outlined in FTA OP 40. The Risk Manager presented an overview of the process demonstrating thru graphical presentations the inputs required into the risk analysis program. The resulting output histogram and the monte carlo analysis were presented and discussed. The risk analysis indicated an 80%-95% confidence level in completing the Program on time utilizing just the standard default software	





ITEM#	DISCUSSION	ACTION BY DUE DATE
	settings for a first run analysis. The Program Master schedule utilized updated contract 1252 schedule and contract 1300 bid schedule critical path items, removing the buffer float, to create a summary level schedule. The Risk Manager provided further explanation of the process, stating the default settings of the risk analysis software are; minimum duration of (0.75), most likely duration of (1.00), and max duration of (1.25). Further refinement of the input is possible by closely examining the durations of key activities; adjustments on each level of the overall activity can then be made if the particular risks justify duration adjustments. One example of this refinement is the head house at YBM: Currently one schedule activity bar represents this work in the summary schedule. If the excavation activity portion of the head house construction contains substantial risk, then the risk analysis could break out the basic activities of the head house construction; setting for the excavation activity could be broken out and assigned specific probabilities such as minimum duration (1.00); most likely duration (1.15); and maximum duration (1.30). The Risk Manager requested the committee to evaluate the data as presented and provide comments regarding the assumptions made in the analysis. In particular, input on specific risks that would affect key activities and the respective probabilities utilized in the analysis.	PM/CM PCC 08/27/13
	The Risk Committee recommended several different versions of the risk analysis be performed, adjusting schedule summary activities to current known risks and assigning probabilistic outcomes to activity durations commensurate with the risk.	* ace of a property
2 -	The next Risk meeting will take place in two weeks August 27, 2013 , to further analyze the results of expanding the duration.	

ACTION ITEMS -

ITEM #	MTG DATE	Task#	DESCRIPTION	BIC	DUE DATE	STATUS
1	12/13/12		Risk 7 – Cost for significant settlement grout	J. Wang	09/12/13	Open
4	12/13/12	l= i.	Risk 72 – 4 th & King (SSWP)	S. Pong C. Morganson	09/12/13	Open
1	08/13/13		Expand/Confirm CN1300 Startup activities	PM/CM	08/27/13	Open
1	08/13/13	n —	Examine additional schedule activities	PCC	08/27/13	Open
1	08/13/13		Schedule duration that are in the Master Schedule	PCC	08/27/13	Open

Meeting adjourned at 4:00pm

These meeting minutes have been prepared by B. Ward and reviewed by E. Stassevitch, and are the preparer's interpretation of discussions that took place. If the reader's interpretation differs, please contact the author in writing within four (4) days of receipt of these minutes.

Signed: Date: Date: Date review completed.]

Risk Mitigation Report No. 48

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Meeting Agenda

Project No. M544.1, Contract No. CS-149
Program/Construction Management
Risk Mitigation Management Meeting No. 48
August 13, 2013
2:00pm – 4:00pm
Central Subway Project Office
821 Howard St. 2nd Floor
Main Conference Room

Attendees:

Mark Benson	Richard Redmond	Roger Nguyen	
Vivian Chow	Albert Hoe	Eric Stassevitch	
Alex Clifford	Mark Latch	Beverly Ward	
John Funghi	Brad Lebovitz	Luis Zurinaga	

- 1. Risk Refresh 2013 Schedule Contingency Assessment
 - Overview of Risk Refresh Process
 - Current Status of Project
 - Schedule Contingency
- 2. Schedule Assessment
 - Risk Analysis Input
 - Summary Schedule Development
 - Minimum; Most Likely; Maximum
 - Current Risk Summary
- 3. Next Steps





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Meeting Attendance Sheet

Project No. M544.1, Contract No. CS-149
Program/Construction Management
Risk Management Meeting No. 48
August 13, 2013
2:00 p.m. – 4:00 p.m.
Central Subway Project Office
821 Howard Street, 2nd Floor
Main Conference Room

Deliver Meeting Attendance Sheet with original signatures/initials to Document Control.

NAME	AFFILIATION	PHONE	E-MAIL (for minutes)	INITIALS
Mark Benson	CSP	415-701-5295	Mark.Benson@sfmta.com	
Vivian Chow	SFMTA	415 701-5264	Vivian.chow.@sfmta.com	valor
Alex Clifford	CSP	415 701- 5275	Alex.clifford@sfmta.com	X
John Funghi	SFMTA	415-701-4299	john.funghi@sfmta.com	(3
Albert Hoe	SFMTA	415-701-4289	albert.hoe@sfmta.com	DIA
Mark Latch	CSP	415-701-5294	mark.latch@sfmta.com	
Brad Lebovitz	STV/PMOC	510-464-8052	Bradley.lebovitz@stvinc.com	BA
Richard Redmond	CSP	415-701-4288	Richard.redmond@sfmta.com	
Eric Stassevitch	CSP	415-701-4426	Eric.stassevitch@sfmta.com	4
Beverly Ward	CSP	415-701-5291	Beverly.ward@sfmta.com	En
Luis Zurinaga	SFCTA	415-716-6956	luis@sfcta.org	Aur
Rogea NGuyan	SFMTA			PSY

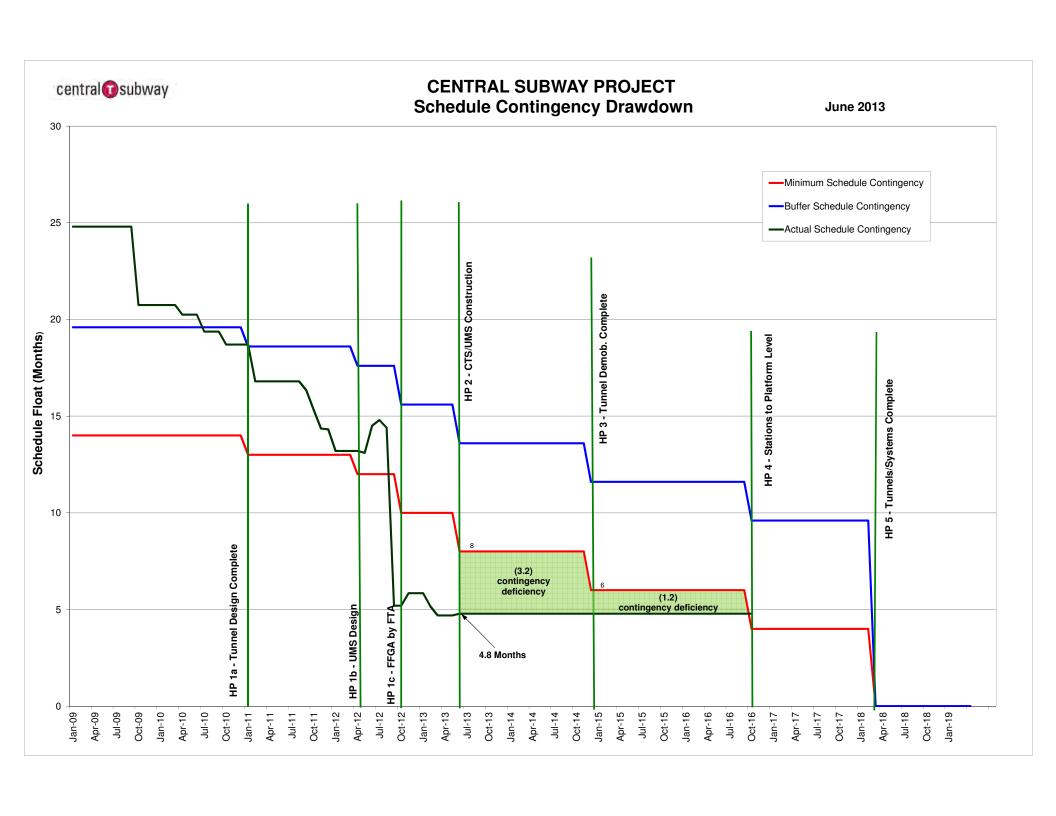


RISK REFRESH 2013

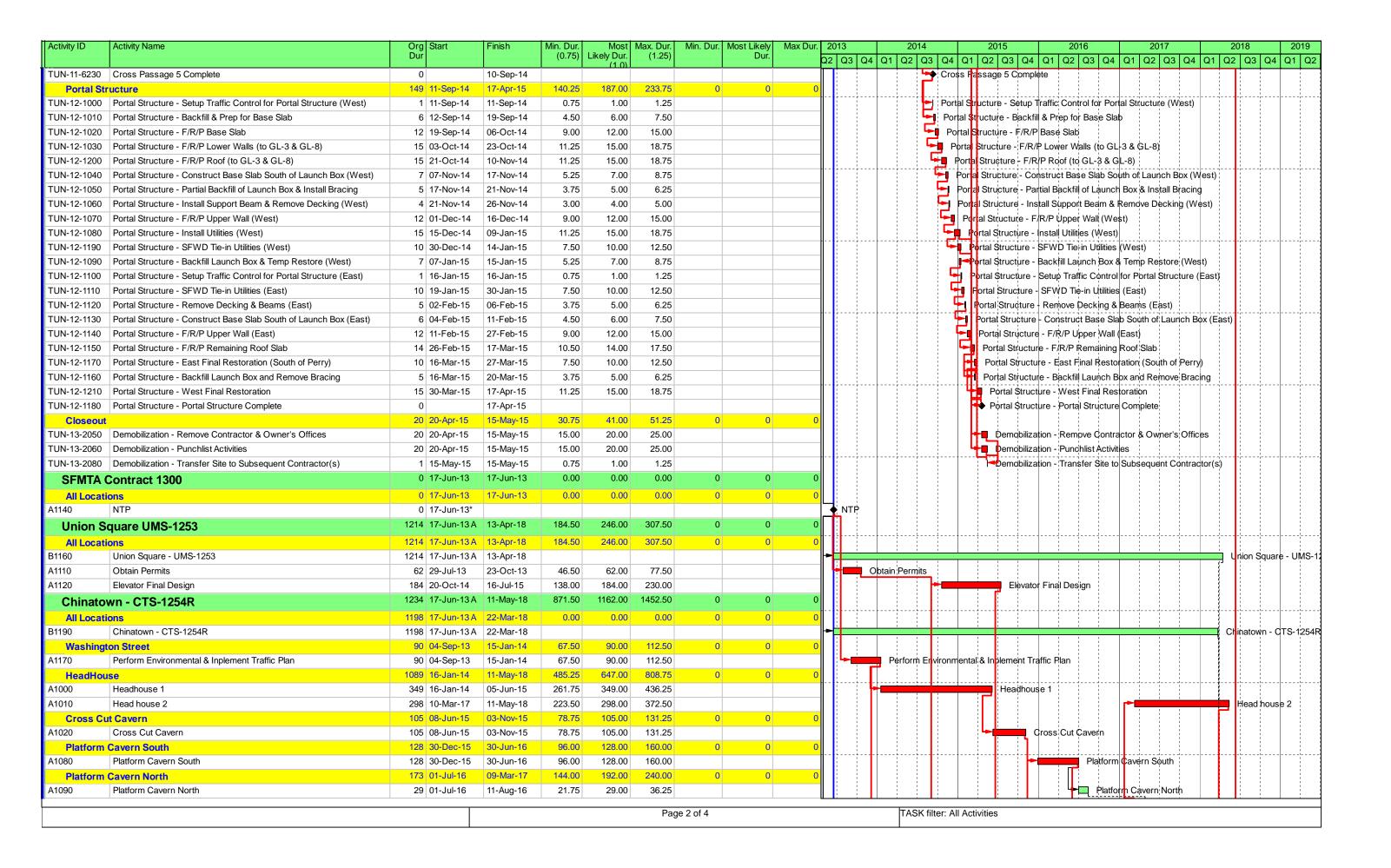
- I. PROJECT BACKGROUND
 - A. PROJECT OVERVIEW
 - B. HISTORY OF PRIOR WORKSHOPS #1, #2, #3, AND #4
 Refresh May 2011
- II. METHODOLOGY AND SCOPE OF REVIEW
 - A. GENERAL
 - B. FTA GUIDANCE and REGULATIONS
 - C. PROJECT REVIEWERS
 - D. GRANTEE SUBMITTALS AND INFORMATION FOR REVIEW
- III. SUMMARY OF PROJECT STATUS
 - A. TECHNICAL CAPACITY AND CAPABILITY REVIEW
 - B. SCOPE REVIEW
 - C. CAPITAL COST ESTIMATE REVIEW
 - D. SCHEDULE REVIEW
- IV. CONTRACT PACKAGING REVIEW
 - A. REVIEW AND ANALYSIS OF CONTRACT PACKAGE STRATEGY
 - B. REVIEW AND ANALYSIS OF RISK ALLOCATION AND ASSESSMENT
- V. RISK IDENTIFICATION-RISK REGISTER
 - A. DEVELOPMENT OF RISK REGISTER
 - B. REVIEW AND ANALYSIS OF RISK IDENTIFICATION-RISK REGISTER
- VI. RISK ASSESSMENT
 - A. COST RISK ANALYSIS
 - B. STANDARD COST CATEGORY ADJUSTMENTS

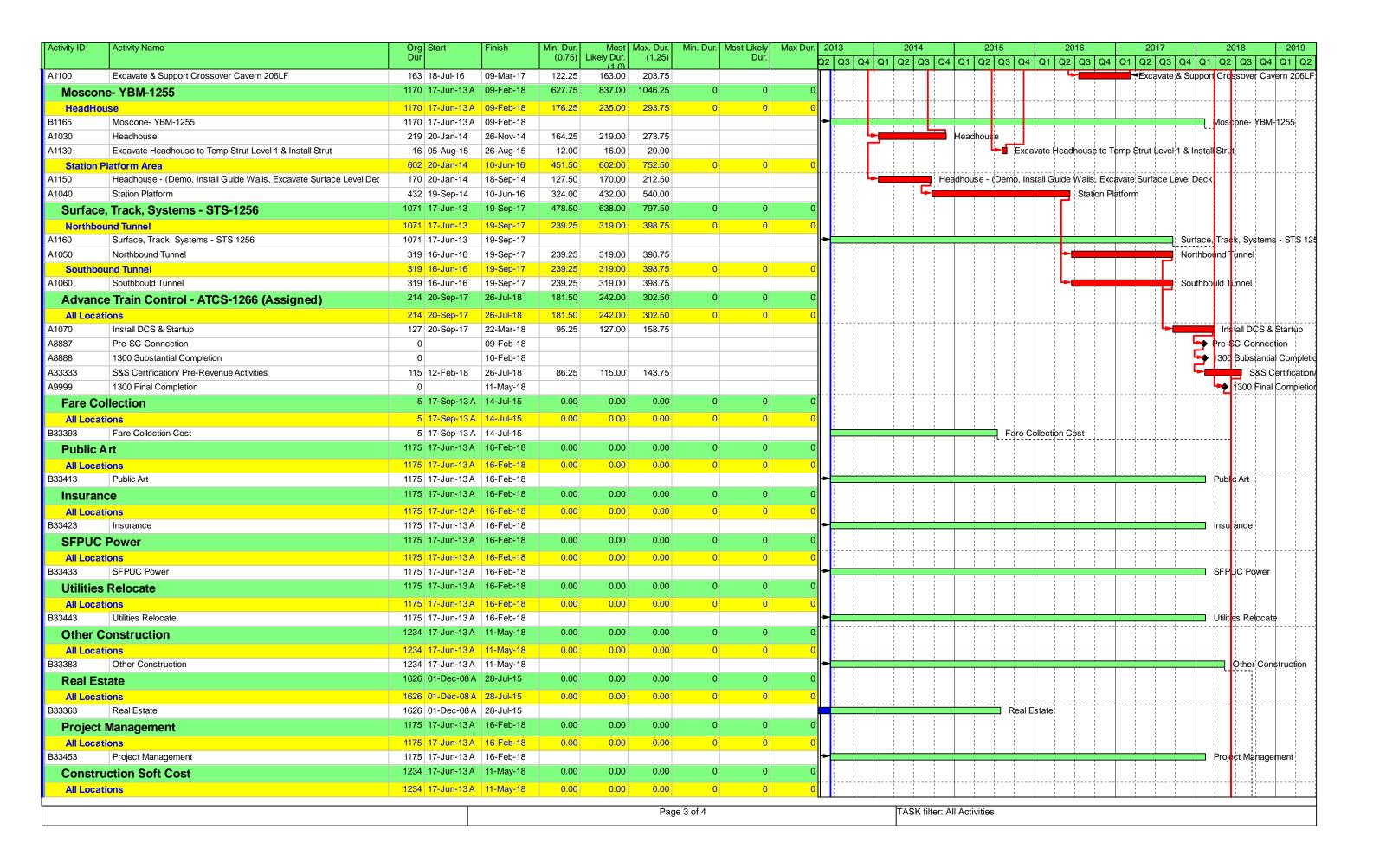
RISK REFRESH 2013

- C. PROJECT COST RISK ASSESSMENT
- D. SCHEDULE ASSESSMENT AND RISK MODELING
- VII. RISK MITIGATION
 - A. PRIMARY MITIGATION
 - **B. SECONDARY MITIGATION**
 - C. CONTINGENCY
- VIII. CONCLUSIONS
- A. SUMMARY OF FINDINGS
- B. RECOMMENDATIONS/PMOC OPINIONS



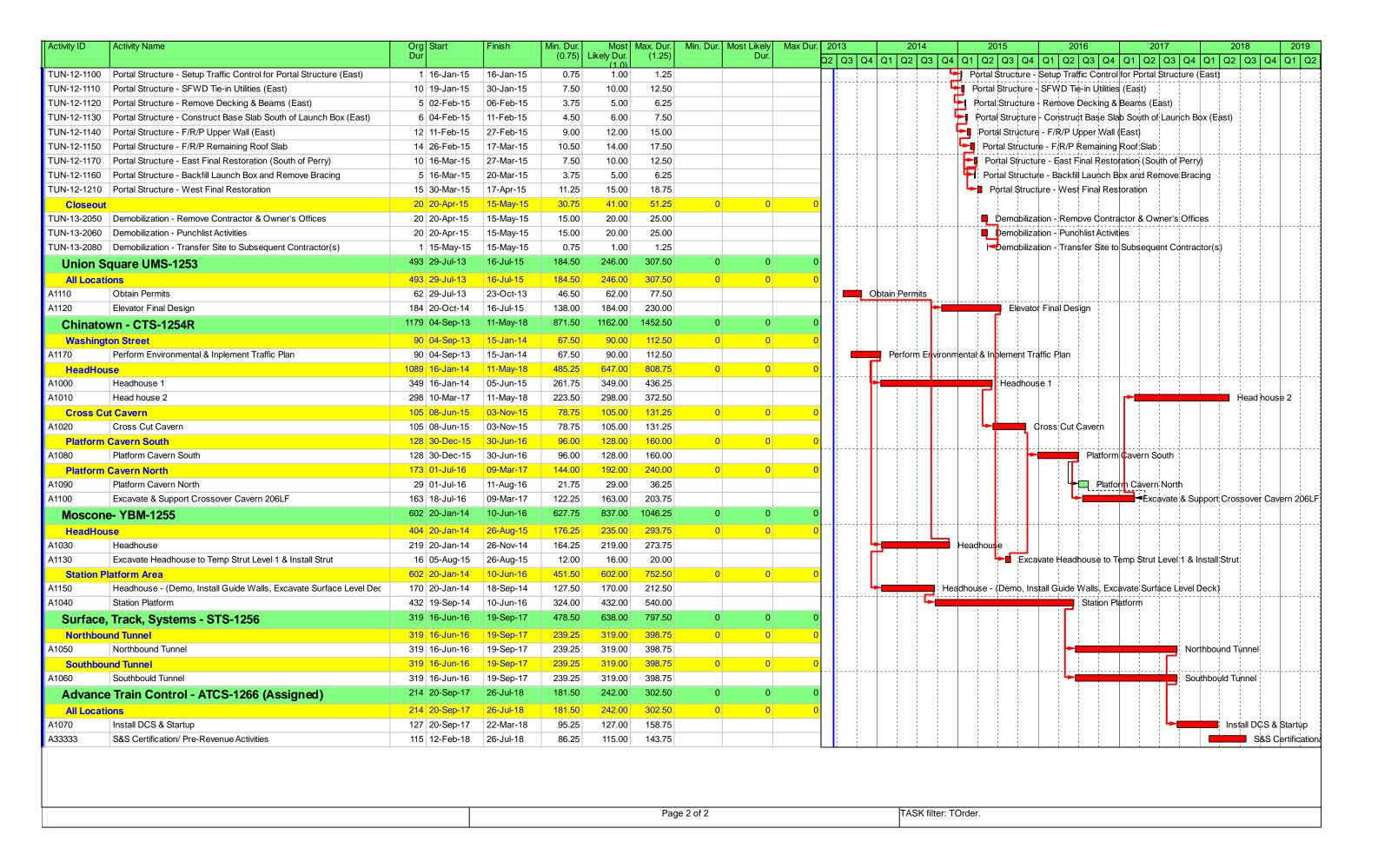
ctivity ID A	ctivity Name	Org Start	Finish	Min. Dur.	Most	Max. Dur.	Min. Dur. Most Lik		ur. 201	
		Dur		(0.75)	Likely Dur. (1.0)	(1.25)		ur.	Q2	Q3 Q4 Q1 Q2 Q3 Q4 Q1
Total		2427 01-Dec-08 A	26-Jul-18	2747.25	3663.00	4578.75	0	0	0	
Phase 1 -	Preliminary Engineering	1175 17-Jun-13 A	16-Feb-18	0.00	0.00	0.00	0	0	0	
All Location	, , ,	1175 17-Jun-13 A	16-Feb-18	0.00	0.00	0.00	0	0	0	
3473 P	hase 1 - Preliminary Eingineering	1175 17-Jun-13 A	16-Feb-18							Phase 1 - Preliminar
Phase 2 -	Final Design	1175 17-Jun-13 A	16-Feb-18	0.00	0.00	0.00	0	0	0	
All Location		1175 17-Jun-13 A	16-Feb-18	0.00	0.00	0.00	0	0	0	
	hase 2 - Final Design	1175 17-Jun-13 A							-	Phasé 2 - Final Des
CSP-1252		521 27-Jan-12 A		403.50	538.00	672.50	0	0	0	
All Location		5 27-Jan-12 A		0.00	0.00	0.00	0	0		
	SP- 1252	5 27-Jan-12 A		0.00	0.00	0.00	U	U	<u> </u>	GSP- 1252
Northbound		187 29-Jul-13	25-Apr-14	141.75	189.00	236.25	0	0	0 :	(0) - 232
	unneling - Assemble Northbound TBM Shield	15 29-Jul-13	16-Aug-13	11.25	15.00	18.75	U		<u> </u>	Tunneling - Assemble Northbound TBM Shield
	unneling - Assemble Northbound TBM Trailing Gear	15 14-Aug-13	04-Sep-13	11.25	15.00	18.75			- [ċ	Tunneling - Assemble Northbound TBM Trailing Gear
	runneling - Test and Commission Northbound TBM	5 03-Sep-13	09-Sep-13	3.75	5.00	6.25				Tunneling - Test and Commission Northbound TBM
	unneling - Test and Commission Northbound 15M	15 09-Sep-13	27-Sep-13	11.25	15.00	18.75			$-\parallel \parallel$	Tunneling - Launch Northbound TBM (163+52 - 160+00)
	funneling - Laurich Northbourid FBM (163+32 - 160+00)	1 30-Sep-13	30-Sep-13	0.75	1.00	1.25				Tunneling - Install Tunnel Ventilation Ducts
	funneling - Tunnel Northbound (160+00 - 156+50)	6 09-Oct-13	16-Oct-13	4.50	6.00	7.50				Tunneling - Trunnel Northbound (160+00 - 156+50)
	funneling - Turniel Northbound (156+50 - 142+30)	23 17-Oct-13	18-Nov-13	17.25	23.00	28.75				Tunneling - Tunnel Northbound (156+50 - 142+30)
	unneling - Tunnel Northbound (156+50 - 142+50)		21-Nov-13			3.75				Tunneling - Tunnel Northbound (190+30 - 142+30)
	,	3 19-Nov-13		2.25	3.00				:	Tunneling - Tunnel Northbound (142+30 - 135+00)
	runneling - Tunnel Northbound (140+50 - 135+00)	9 22-Nov-13	06-Dec-13	6.75	9.00	11.25				🖶 - `` 🚅 - ``
	unneling - Tunnel Under Existing Bart Tunnels	0 02-Dec-13	00 D 40	0.00	0.00	0.00				Tunneling - Tunnel Under Existing Bart Tunnels
	unneling - Tunnel Northbound (135+00 - 128+00)	11 09-Dec-13	23-Dec-13	8.25	11.00	13.75				Tunneling - Tunnel Northbound (135+00 - 128+00)
	unneling - Tunnel Northbound (128+00 - 103+00)	41 26-Dec-13	25-Feb-14	30.75	41.00	51.25				Tunneling - Tunnel Northbound (128+00 - 103+00)
	unneling - Tunnel Northbound (103+00 - 88+00)	23 24-Feb-14	26-Mar-14	17.25	23.00	28.75			_	Tunneling - Tunnel Northbound (103+00' - 88+00)
	runneling - Tunnel Northbound (88+00 - 85+50)	5 27-Mar-14	02-Apr-14	3.75	5.00	6.25				Tunneling - Tunnel Northbound (88+00 - 85+50)
	unneling - Tunnel Northbound (85+50 - 81+20)	7 03-Apr-14	11-Apr-14	5.25	7.00	8.75			_	Tunneling - Tunnel Northbound (85+50 - 81+20)
	unneling - Tunnel Northbound (81+20 - 78+40)- to Pagoda	10 14-Apr-14	25-Apr-14	7.50	10.00	12.50		0		Tunneling - Tunnel Northbound (81+20 - 78+40)- to Pagoda
Southbound		66 17-Jun-13 A		19.50	26.00	32.50	0	0	<u> </u>	
	unneling - Test and Commission Southbound TBM	5 17-Jun-13 A		3.75	5.00	6.25			_ .	uhneling - Test and Commission Southbound TBM
	runneling - Launch Southbound TBM (163+52 - 160+00)	15 08-Jul-13	26-Jul-13	11.25	15.00	18.75				Tunneling Launch Southbound TBM (163+52 - 160+00)
	unneling - Tunnel Southbound (160+00 - 156+50)	6 01-Oct-13	08-Oct-13	4.50	6.00	7.50				Tunneling - Tunnel Southbound (160+00 - 156+50)
Contract M		20 17-Apr-15	15-May-15	0.00	0.00	0.00	0	0	0	
	substantial Completion (NTP1 + 1157 CD + 14 CD for Pagoda)	0	17-Apr-15*						_	Substantial Completion (NTP1 + 1157 CD + 14 CD for Pagoda)
	inal Completion (NTP1 + 1187 CD + 14 CD for Pagoda)	0	15-May-15*			10.05				Final Completion (NTP1 + 1187 CD + 14 CD for Pagoda)
Cross Pass	3.5	37 28-Apr-14	18-Jun-14	27.75	37.00	46.25	0	0	0	
	cross Passage 2 - Excavate and Install Initial Support	15 28-Apr-14	16-May-14	11.25	15.00	18.75			_	Cross Passage 2 - Excavate and Install Initial Support
	cross Passage 2 - Construct Final Liner (Invert)	7 19-May-14	28-May-14	5.25	7.00	8.75			_	Cross Passage 2 - Construct Final Liner (Invert)
	cross Passage 2 - Construct Final Liner (Arch)	15 29-May-14	18-Jun-14	11.25	15.00	18.75			_	Cross Passage 2 - Construct Final Liner (Arch)
	cross Passage 2 Complete	0	18-Jun-14	11.5		10 ==				Cross Passage 2 Complete
Cross Pass		15 19-Jun-14	10-Jul-14	11.25	15.00	18.75	0	0	0	
	cross Passage 4 - Excavate & Install Initial Support	15 19-Jun-14	10-Jul-14	11.25	15.00	18.75			_	Cross Passage 4 - Excavate & Install Initial Support
Cross Pass	<u> </u>	43 11-Jul-14	10-Sep-14	32.25	43.00	53.75	0	0	0	
	cross Passage 5 - Excavate & Install Initial Support (Cross Passage)	15 11-Jul-14	31-Jul-14	11.25	15.00	18.75			_	Cross Passage 5 - Excavate & Install Initial Support (Cross Passage)
	cross Passage 5 - Excavate & Install Initial Support (Sump)	2 01-Aug-14	04-Aug-14	1.50	2.00	2.50			_	Cross Passage 5 - Excavate & Install Initial Support (Sump)
	cross Passage 5 - Construct Final Liner (Sump)	5 05-Aug-14	11-Aug-14	3.75	5.00	6.25				Cross Passage 5 - Construct Final Liner (Sump)
	cross Passage 5 - Construct Final Liner (Invert)	5 12-Aug-14	18-Aug-14	3.75	5.00	6.25			_	Cross Pa <mark>s</mark> sage 5 - Construct Final Liner (Invert)
	cross Passage 5 - Construct Final Liner (Arch)	15 19-Aug-14	09-Sep-14	11.25	15.00	18.75			_	Cross Passage 5 - Construct Final Liner (Arch)
N-11-6220 C	ross Passage 5 - Install Misc Metals	1 10-Sep-14	10-Sep-14	0.75	1.00	1.25				Cross P <mark>a</mark> ssage 5 - Install Misc Metals





Activity ID	Activity Name	Org Start	Finish	Min. Dur.	Most	Max. Dur.	Min. Dur. I	Most Likely	Max Dur.	201	3		2014		2015		2016		17	2	.018	2019
		Dur		(0.75)	Most Likely Dur. (1.0)	(1.25)		Dur.				4 Q1		Q4 Q1	1 Q2 Q3 Q4							
B33403	Construction Soft Cost	1234 17-Jun-13 A	11-May-18		(1.0)					-	+	+ +	_			-						ction Soft Co
Light Ra	ail Vehicle	1195 15-Apr-13 A	19-Mar-18	0.00	0.00	0.00	0	0	0													
All Location		1195 15-Apr-13 A	19-Mar-18	0.00	0.00	0.00	0	0	0				-									
	Light Rail vehicles	1195 15-Apr-13 A															1 1			Lig	ht Rail ve	ehicles
	& Testing	1175 17-Jun-13 A		0.00	0.00	0.00	0	0	0													
All Locati		1175 17-Jun-13 A	16-Feb-18	0.00	0.00	0.00	0	0	0				į									
	Startup	1175 17-Jun-13 A								┡	- 1		1	1			1 1	1 1	!	Star	up	
	venue Service Date	0 26-Jul-18		0.00	0.00	0.00	0	0	0		!		-									
All Location			26-Jul-18	0.00		0.00	0	0	0													
	Revenue Operation Date		26-Jul-18					-													Rev	enue Opera
	<u> </u>													: 1	-			- : :	:	1 :	- : - : -	"

CSP Risk Analysis Schedule - Rev 0						Date: 13-AUG-201;
Activity ID Activity Name	Org Start	Finish	Min. Dur.	Most		in. Dur. Most Likely Max Dur. 2013 2014 2015 2016 2017 2018 2019
	Dur		(0.75)	Likely Dur.	(1.25)	Dur. Dur. Q2 Q3 Q4 Q1 Q2
Total	1271 17-Jun-13 A	26-Jul-18	2747.25	3663.00	4578.75	
CSP-1252	466 17-Jun-13 A	15-May-15	403.50	538.00	672.50	
Northbound Tunnel	187 29-Jul-13	25-Apr-14	141.75	189.00	236.25	
TUN-06-1000 Tunneling - Assemble Northbound TBM Shield	15 29-Jul-13	16-Aug-13	11.25	15.00	18.75	Tunneling - Assemble Northbound TBM Shield
TUN-06-1170 Tunneling - Assemble Northbound TBM Trailing Gear	15 14-Aug-13	04-Sep-13	11.25	15.00	18.75	Tunneling - Assemble Northbound TBM Trailing Gear
TUN-06-1010 Tunneling - Test and Commission Northbound TBM	5 03-Sep-13	09-Sep-13	3.75	5.00	6.25	Tunneling - Test and Commission Northbound TBM
TUN-06-1020 Tunneling - Launch Northbound TBM (163+52 - 160+00)	15 09-Sep-13	27-Sep-13	11.25	15.00	18.75	Tunneling - Launch Northbound TBM (163+52 - 160+00)
TUN-07-1030 Tunneling - Install Tunnel Ventilation Ducts	1 30-Sep-13	30-Sep-13	0.75	1.00	1.25	Tunnelirig - Iristall Tunnel Ventilation Ducts
TUN-06-1040 Tunneling - Tunnel Northbound (160+00 - 156+50)	6 09-Oct-13	16-Oct-13	4.50	6.00	7.50	Tunneling - Tunnel Northbound (160+00 - 156+50)
TUN-06-1050 Tunneling - Tunnel Northbound (156+50 - 142+30)	23 17-Oct-13	18-Nov-13	17.25	23.00	28.75	Tunneling - Tunnel Northbound (156+50 - 142+30)
TUN-06-1060 Tunneling - Tunnel Northbound (142+30 - 140+50)	3 19-Nov-13	21-Nov-13	2.25	3.00	3.75	Tunneling - Tunnel Northbound (142+30 - 140+50)
TUN-06-1070 Tunneling - Tunnel Northbound (140+50 - 135+00)	9 22-Nov-13	06-Dec-13	6.75	9.00	11.25	Tunneling - Tunnel Northbound (140+50 - 135+00)
, ,	0 02-Dec-13	00-Dec-13				Tunneling - Tunnel Under Existing Bart Tunnels
ů ů		22 Doc 42	0.00	0.00	0.00	
,	11 09-Dec-13	23-Dec-13	8.25	11.00	13.75	Tunneling - Tunnel Northbound (135+00) - 128+00) Tunneling - Tunnel Northbound (128+00 - 103+00)
TUN-06-1150 Tunneling - Tunnel Northbound (128+00 - 103+00)	41 26-Dec-13	25-Feb-14	30.75	41.00	51.25	
TUN-06-1140 Tunneling - Tunnel Northbound (103+00 - 88+00)	23 24-Feb-14	26-Mar-14	17.25	23.00	28.75	Tunneling - Tunnel Northbound (103+00 - 88+00)
TUN-06-1090 Tunneling - Tunnel Northbound (88+00 - 85+50)	5 27-Mar-14	02-Apr-14	3.75	5.00	6.25	Tunneling - Tunnel Northbound (88+00 - 85+50)
TUN-06-1100 Tunneling - Tunnel Northbound (85+50 - 81+20)	7 03-Apr-14	11-Apr-14	5.25	7.00	8.75	Tunneling - Tunnel Northbound (85+50 - 81+20)
TUN-06-1200 Tunneling - Tunnel Northbound (81+20 - 78+40)- to Pagoda	10 14-Apr-14	25-Apr-14	7.50	10.00	12.50	Tunneling - Tunnel Northbound (81+20 - 78+40) - to Pagoda
Southbound Tunnel	66 17-Jun-13 A		19.50	26.00	32.50	
TUN-07-1010 Tunneling - Test and Commission Southbound TBM	5 17-Jun-13 A		3.75	5.00	6.25	unneling - Test and Commission Southbound TBM
TUN-07-1020 Tunneling - Launch Southbound TBM (163+52 - 160+00)	15 08-Jul-13	26-Jul-13	11.25	15.00	18.75	Tunneling Launch Southbound TBM (163+52 - 160+00)
TUN-07-1050 Tunneling - Tunnel Southbound (160+00 - 156+50)	6 01-Oct-13	08-Oct-13	4.50	6.00	7.50	Tunneling - Tunnel Southbound (160+00 - 156+50)
Cross Passages 2	37 28-Apr-14	18-Jun-14	27.75	37.00	46.25	
TUN-11-3000 Cross Passage 2 - Excavate and Install Initial Support	15 28-Apr-14	16-May-14	11.25	15.00	18.75	Cross Passage 2 - Excavate and Install Initial Support
TUN-11-3010 Cross Passage 2 - Construct Final Liner (Invert)	7 19-May-14	28-May-14	5.25	7.00	8.75	Cross Passage 2 - Construct Final Liner (Invert)
TUN-11-3030 Cross Passage 2 - Construct Final Liner (Arch)	15 29-May-14	18-Jun-14	11.25	15.00	18.75	Cross Passage 2 - Construct Final Liner (Arch)
Cross Passages 4	15 19-Jun-14	10-Jul-14	11.25	15.00	18.75	
TUN-11-5000 Cross Passage 4 - Excavate & Install Initial Support	15 19-Jun-14	10-Jul-14	11.25	15.00	18.75	Cross Passage 4 - Excavate & Install Initial Support
Cross Passages 5	43 11-Jul-14	10-Sep-14	32.25	43.00	53.75	
TUN-11-6200 Cross Passage 5 - Excavate & Install Initial Support (Cross Passage)	15 11-Jul-14	31-Jul-14	11.25	15.00	18.75	Cross Passage 5 - Excavate & Install Initial Support (Cross Passage)
TUN-11-6260 Cross Passage 5 - Excavate & Install Initial Support (Sump)	2 01-Aug-14	04-Aug-14	1.50	2.00	2.50	Cross Passage 5 - Excavate & Install Initial Support (\$ump)
TUN-11-6210 Cross Passage 5 - Construct Final Liner (Sump)	5 05-Aug-14	11-Aug-14	3.75	5.00	6.25	Cross Passage 5 - Construct Final Liner (Sump)
TUN-11-6240 Cross Passage 5 - Construct Final Liner (Invert)	5 12-Aug-14	18-Aug-14	3.75	5.00	6.25	Cross Passage 5 - Construct Final Liner (Invert)
TUN-11-6250 Cross Passage 5 - Construct Final Liner (Arch)	15 19-Aug-14	09-Sep-14	11.25	15.00	18.75	Cross Passage 5 - Construct Final Liner (Arch)
TUN-11-6220 Cross Passage 5 - Install Misc Metals	1 10-Sep-14	10-Sep-14	0.75	1.00	1.25	Cross Passage 5 - Install Misc Metals
Portal Structure	149 11-Sep-14	17-Apr-15	140.25	187.00	233.75	
TUN-12-1000 Portal Structure - Setup Traffic Control for Portal Structure (West)	1 11-Sep-14	11-Sep-14	0.75	1.00	1.25	J Portal Structure - Setup Traffic Control for Portal Structure (West)
TUN-12-1010 Portal Structure - Backfill & Prep for Base Slab	6 12-Sep-14	19-Sep-14	4.50	6.00	7.50	Portal Structure - Backfill & Prep for Base Slab
TUN-12-1020 Portal Structure - F/R/P Base Slab	12 19-Sep-14	06-Oct-14	9.00	12.00	15.00	Portal Structure - F/R/P Base Slab
TUN-12-1030 Portal Structure - F/R/P Lower Walls (to GL-3 & GL-8)	15 03-Oct-14	23-Oct-14	11.25	15.00	18.75	Portal Structure - F/R/P Lower Walls (to GL-3 & GL-8)
TUN-12-1200 Portal Structure - F/R/P Roof (to GL-3 & GL-8)	15 21-Oct-14	10-Nov-14	11.25	15.00	18.75	Portal Structure - F/R/P Roof (to GL-3 & GL-8)
TUN-12-1040 Portal Structure - Construct Base Slab South of Launch Box (West)	7 07-Nov-14	17-Nov-14	5.25	7.00	8.75	Portal Structure:- Construct Base Slab South of Laurich Box (West)
TUN-12-1050 Portal Structure - Partial Backfill of Launch Box & Install Bracing	5 17-Nov-14	21-Nov-14	3.75	5.00	6.25	Portal Structure - Partial Backfill of Launch Box & Install Bracing
TUN-12-1060 Portal Structure - Install Support Beam & Remove Decking (West)	4 21-Nov-14	26-Nov-14	3.00	4.00	5.00	Portal Structure - Install Support Beam & Remove Decking (West)
TUN-12-1070 Portal Structure - F/R/P Upper Wall (West)	12 01-Dec-14	16-Dec-14	9.00	12.00	15.00	Portal Structure - F/R/P Upper Wall (West)
TUN-12-1080 Portal Structure - Install Utilities (West)	15 15-Dec-14	09-Jan-15	11.25	15.00	18.75	Portal Structure - Install Utilities (West)
TUN-12-1190 Portal Structure - FSWD Tie-in Utilities (West)	10 30-Dec-14	14-Jan-15	7.50	10.00	12.50	Portal Structure - SFWD Tie-in Utilities (West)
TUN-12-1090 Portal Structure - Backfill Launch Box & Temp Restore (West)	7 07-Jan-15	15-Jan-15	5.25	7.00	8.75	Portal Structure - Backfill Launch Box & Temp Restore (West)
1 ortal ortalitation - Daokiiii Laurion Dox & Temp (Nestore (West)	7 07-3411-13	10-Jail-13	3.23	7.00		
					Page 1	of 2 TASK filter: TOrder.



ctivity ID Activity Name	Org	Start	Finish	Min. Dur.	Most	Max. Dur.	Min. Dur. Most L		Dur. 2	2013	2014	2015		2016	2017		2018	201
	Dur			(0.75)	Likely Dur.	(1.25)		Dur.	Q:	2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 (Q4 Q1	Q2 Q3 Q4	Q1 Q2 Q	3 Q4 Q1 (Q2 Q3 C	Q4 Q1
Total	2427	01-Dec-08 A	26-Jul-18	2747.25	3663.00	4578.75	0	0	0									
Phase 1 - Preliminary Engineering	1175	17-Jun-13 A	16-Feb-18	0.00	0.00	0.00	0	0	0				1					
Phase 2 - Final Design	1175	17-Jun-13 A	16-Feb-18	0.00	0.00	0.00	0	0	0									
CSP-1252	521	27-Jan-12 A	30-Jul-15	403.50	538.00	672.50	0	0	0									
All Locations			30-Jul-15	0.00	0.00	0.00	0	0	0									
Northbound Tunnel		29-Jul-13	25-Apr-14	141.75	189.00	236.25	0	0	0									
Southbound Tunnel			08-Oct-13	19.50	26.00	32.50	0	0	0									
Contract Milestones		17-Apr-15	15-May-15	0.00	0.00	0.00	0	0	0									
Cross Passages 2	37	28-Apr-14	18-Jun-14	27.75	37.00	46.25	0	0	0		•••							
Cross Passages 4	15	19-Jun-14	10-Jul-14	11.25	15.00	18.75	0	0	0									
Cross Passages 5	43	11-Jul-14	10-Sep-14	32.25	43.00	53.75	0	0	0									
Portal Structure	149	11-Sep-14	17-Apr-15	140.25	187.00	233.75	0	0	0									
Closeout		20-Apr-15	15-May-15	30.75	41.00	51.25	0	0	0			-						
SFMTA Contract 1300	0	17-Jun-13	17-Jun-13	0.00	0.00	0.00	0	0	0									
All Locations	0	17-Jun-13	17-Jun-13	0.00	0.00	0.00	0	0	0									
Union Square UMS-1253	1214	17-Jun-13 A	13-Apr-18	184.50	246.00	307.50	0	0	0									
All Locations	1214	17-Jun-13 A	13-Apr-18	184.50	246.00	307.50	0	0	0		_							
Chinatown - CTS-1254R	1234	17-Jun-13 A	11-May-18	871.50	1162.00	1452.50	0	0	0									
All Locations	1198	17-Jun-13 A	22-Mar-18	0.00	0.00	0.00	0	0	0									
Washington Street	90	04-Sep-13	15-Jan-14	67.50	90.00	112.50	0	0	0		•		1					
HeadHouse	1089	16-Jan-14	11-May-18	485.25	647.00	808.75	0	0	0									
Cross Cut Cavern	105	08-Jun-15	03-Nov-15	78.75	105.00	131.25	0	0	0				•					
Platform Cavern South	128	30-Dec-15	30-Jun-16	96.00	128.00	160.00	0	0	0					<u> </u>				
Platform Cavern North		01-Jul-16	09-Mar-17	144.00	192.00	240.00	0	0	0						-			
Moscone- YBM-1255	1170	17-Jun-13 A	09-Feb-18	627.75	837.00	1046.25	0	0	0									
HeadHouse	1170	17-Jun-13 A	09-Feb-18	176.25	235.00	293.75	0	0	0									
Station Platform Area		20-Jan-14	10-Jun-16	451.50	602.00	752.50	0	0	0				1	_				
Surface, Track, Systems - STS-1256	1071	17-Jun-13	19-Sep-17	478.50	638.00	797.50	0	0	0									
Northbound Tunnel	1071	17-Jun-13	19-Sep-17	239.25	319.00	398.75	0	0	0							=		
Southbound Tunnel		16-Jun-16	19-Sep-17	239.25	319.00	398.75	0	0	0									
Advance Train Control - ATCS-1266 (Assigned)	214	20-Sep-17	26-Jul-18	181.50	242.00	302.50	0	0	0								-	
Fare Collection	5	17-Sep-13 A	14-Jul-15	0.00	0.00	0.00	0	0	0									
Public Art	1175	17-Jun-13 A	16-Feb-18	0.00	0.00	0.00	0	0	0									
Insurance	1175	17-Jun-13 A	16-Feb-18	0.00	0.00	0.00	0	0	0									
SFPUC Power	1175	17-Jun-13 A	16-Feb-18	0.00	0.00	0.00	0	0	0									
Utilities Relocate			16-Feb-18	0.00		0.00	0	0	0									-
			11-May-18	0.00		0.00	0	0	0									
Other Construction									0									
Real Estate			28-Jul-15	0.00		0.00	0	0	0									
Project Management			16-Feb-18	0.00	0.00	0.00	0	0	0									
Construction Soft Cost	1234	17-Jun-13 A	11-May-18	0.00	0.00	0.00	0	0	0									
Light Rail Vehicle	1195	15-Apr-13 A	19-Mar-18	0.00	0.00	0.00	0	0	0									
Startup & Testing	1175	17-Jun-13 A	16-Feb-18	0.00	0.00	0.00	0	0	0									
CSP Revenue Service Date		26-Jul-18	26-Jul-18	0.00		0.00	0	0	0								1 1	
All Locations		26-Jul-18	26-Jul-18	0.00		0.00	0	0	0									
All Locations		20-0ul-10	20 Jul 10	0.00	0.00	0.00			- 0	l:		<u> </u>			<u> </u>	<u> </u>	<u> </u>	

P Risk Analysis Schedule - Rev 0 tivity ID Activity Name	Org	Start	Finish	Budgeted Total	Actual Total Cost	Remaining Total	At Completion Total	2013		20 ⁻	14		2015		201	3		2017		2	018	201
Activity Name	Dur	Start	TITIOTT	Cost	riotuai Totai Gust	Cost			Q4 Q					Q4 Q1		Q3 Q4			Q4			
Total	2427	01-Dec-08 A	26-Jul-18	\$1,498,777,125	\$356,020,116	\$1,142,757,009	\$1,498,777,125															
Phase 1 - Preliminary Engineering	1175	17-Jun-13 A	16-Feb-18	\$47,327,736	\$47,327,736	\$0	\$47,327,736															
Phase 2 - Final Design	1175	17-Jun-13 A	16-Feb-18	\$63,560,452	\$61,048,006	\$2,512,446	\$63,560,452									!			!			1
CSP-1252	521	27-Jan-12 A	30-Jul-15	\$230,878,499	\$124,600,587	\$106,277,912	\$230,878,499															1
All Locations			30-Jul-15	\$230,878,499	\$124,600,587	\$106,277,912	\$230,878,499															
Northbound Tunnel		29-Jul-13	25-Apr-14	\$0	\$124,000,387	\$100,277,912	\$0															
Southbound Tunnel			08-Oct-13	\$0	\$0	\$0	\$0															
Contract Milestones		17-Apr-15	15-May-15	\$0	\$0	\$0	\$0															
Cross Passages 2		28-Apr-14	18-Jun-14	\$0	\$0	\$0	\$0															
Cross Passages 4	15	19-Jun-14	10-Jul-14	\$0	\$0	\$0	\$0			į	1											
Cross Passages 5	43	11-Jul-14	10-Sep-14	\$0	\$0	\$0	\$0															
Portal Structure	149	11-Sep-14	17-Apr-15	\$0	\$0	\$0	\$0				—											
Closeout	20 2	20-Apr-15	15-May-15	\$0	\$0	\$0	\$0				-		•									
SFMTA Contract 1300	0	17-Jun-13	17-Jun-13	\$0	\$0	\$0	\$0															
All Locations	0	17-Jun-13	17-Jun-13	\$0	\$0	\$0	\$0															
Union Square UMS-1253	1214	17-Jun-13 A	13-Apr-18	\$247,567,810	\$0	\$247,567,810	\$247,567,810												1			
All Locations	1214	17-Jun-13 A	13-Apr-18	\$247,567,810	\$0	\$247,567,810	\$247,567,810		•			+ +	-									
Chinatown - CTS-1254R	1234	17-Jun-13 A	11-May-18	\$294,030,590	\$0	\$294,030,590	\$294,030,590															
All Locations	1198	17-Jun-13 A	22-Mar-18	\$294,030,590	\$0	\$294,030,590	\$294,030,590					1										
Washington Street	90 (04-Sep-13	15-Jan-14	\$0	\$0	\$0	\$0									1						
HeadHouse	1089	16-Jan-14	11-May-18	\$0	\$0	\$0	\$0		_							:	-					
Cross Cut Cavern	105 (08-Jun-15	03-Nov-15	\$0	\$0	\$0	\$0															
Platform Cavern South		30-Dec-15	30-Jun-16	\$0	\$0	\$0	\$0															
Platform Cavern North		01-Jul-16	09-Mar-17	\$0	\$0	\$0	\$0								1		_					
Moscone- YBM-1255			09-Feb-18	\$158,089,000	\$0		\$158,089,000										<u> </u>		<u>.</u>		ļļ.	
HeadHouse			09-Feb-18	\$158,089,000	\$0		\$158,089,000			+ +												
Station Platform Area		20-Jan-14	10-Jun-16	\$0	\$0	\$0	\$0			; ;	-	1	: :									1
Surface, Track, Systems - STS-1256	1071	17-Jun-13	19-Sep-17	\$139,989,000	\$0		\$139,989,000															
Northbound Tunnel		17-Jun-13	19-Sep-17	\$139,989,000	\$0	,,	\$139,989,000					1			-	1	- 1	:	l¦			
Southbound Tunnel			19-Sep-17	\$0	\$0	\$0	\$0														<u> </u>	
Advance Train Control - ATCS-1266 (Assigned)			26-Jul-18	\$0	\$0		\$0					1							:		7	1
Fare Collection			14-Jul-15	\$2,400,000	\$0	\$2,400,000	\$2,400,000					1										
Public Art	1175	17-Jun-13 A	16-Feb-18	\$13,111,208	\$1,862,745	\$11,248,463	\$13,111,208															
Insurance	1175	17-Jun-13 A	16-Feb-18	\$9,808,750	\$9,271,240	\$537,510	\$9,808,750															
SFPUC Power	1175	17-Jun-13 A	16-Feb-18	\$8,500,713	\$2,569,222	\$5,931,491	\$8,500,713															
Utilities Relocate	1175	17-Jun-13 A	16-Feb-18	\$32,811,715	\$32,762,732	\$48,983	\$32,811,715															
Other Construction			11-May-18	\$8,205,605	(\$7,671,929)	\$15,877,534	\$8,205,605															
			28-Jul-15	\$36,358,758	\$17,115,675	\$19,243,083	\$36,358,758															
Real Estate												1										1
Project Management			16-Feb-18	\$109,399,068	\$58,801,063	\$50,598,005	\$109,399,068															1
Construction Soft Cost			11-May-18	\$63,132,876	\$8,089,594	\$55,043,282	\$63,132,876												-			
Light Rail Vehicle	1195	15-Apr-13 A	19-Mar-18	\$26,385,653	\$97,298	\$26,288,355	\$26,385,653															
Startup & Testing	1175	17-Jun-13 A	16-Feb-18	\$7,219,692	\$146,147	\$7,073,545	\$7,219,692															
CSP Revenue Service Date	0 2	26-Jul-18	26-Jul-18	\$0	\$0	\$0	\$0															
All Locations		26-Jul-18	26-Jul-18	\$0	\$0	\$0	\$0															1
. III EUVANONO				40	40	40	40	<u> </u>		1 1		1 !	!!!		1 1	1		!	!	!	1 1	

CENTRAL SUBWAY RISK SUMMARY

Risk#	Risk Description	Risk Owner	Risk Category	Risk Rating	Status	Contract
99	Breakdown in relationships between SFMTA and Contractors during construction results in increased claims and delays to the overall construction schedule.	MB	С	8	7/27/12 FDS 1940	GEN
F	Underground obstructions Stations (UMS)	JW	С	8	8/12/15 UMS 1320	UMS
F	Underground obstructions stations (CTS)	QC	С	8	10/9/17 CTS1500	стѕ
F	Underground obstructions Stations (MOS)	QC	С	8	4/28/15 MOS1150	MOS
70	Change in traffic control requirements after bid.	RR	С	8	5/22/17 STS1020	GEN
83	Cost of vehicles may be more than estimated due to sole source and small order	LA	R	8	11/17/17 STS 1500	GEN
203	Headwalls interface delay 1300 Contractor (SSTS)	MB	С	8		SSTS
208	Additional cost if we change direction going to the Pagoda	RR/MB	С	8		TUN
46	Public complaints result in unanticipated restrictions on construction at CTS. (schedule and estimate for underground work assumes 6 day work week and 2 shifts per day)	MB/BC	С	6	10/9/17 CTS1500	CTS
52	Unacceptable settlement and impact on major utilities at CTS. (OLD SEWERS AND OTHERS WITHIN 20FT SPACE BETWEEN TOP OF CAVERN AND STREET LEVEL)	RR	С	6	4/22/16 N-CTS9730	стѕ
204	AT&T Vault - New Sewer Work south of Bryant	RR/MB	С	6	11 0100100	SSTS
В	Storage and testing of excavated soils from tunnel limits advance rate of tunneling.	SW	С	6	2/5/14 TUN1124	TUN
34	Loss of business results in unanticipated restrictions on construction at UMS.	RR	С	5	9/7/16 UMS1430	UMS
72	Interface new Signaling and Train Control system to existing at Fourth and King	SP	С	5	3/4/16 STS1045	STS
104	CPUC approval at Grade Crossing for G0164d takes longer to negotiate / obtain than	SP	R	5	7/27/12 FDS 1940	STS
E	schedule allows Underground obstructions tunnel and retrieval shaft	SW	С	5	2/5/14	TUN
т	Delay on station emergency ventilation approval	JW	R	5	TUN1124 7/27/12	GEN
16	TBM loss and / or damaged in Transit	MB	С	5	FDS 1940 5/20/13	TUN
67	Archeological/Cultural findings during construction increases schedule and/or cost.	MB	С	5	TUN1095 8/12/15	UMS
	(UMS)LESS THAN 1% Archeological/Cultural findings during construction increases schedule and/or cost.				UMS1320 10/9/17	
68	(CHINA TOWN)AROUND 10% Potential for excessive settlement of BART tunnels - SIGNIFICANT COMPENSATION	MB	С	5	CTS1500 8/28/13	CTS
7	GROUT REQUIRED OVER ESTIMATE ALLOWANCES	SW	С	4	TUN1120 12/30/20	TUN
111	Major Earthquake stops work	AW	С	4	MS 0010 12/30/20	GEN
112	Major safety event halts work	MB	С	4	MS 0010	GEN
116	TBM procurement, delivery and assembly takes longer than assumed in schedule. The process of acquiring station licenses: acquisition/condemnation could significantly	MB	С	4	5/20/13 TUN1095	TUN
196	delay schedule and cost more than that presently planned.	RR	С	4	00/40	GEN
210	Mission Bay Loop Grant – Needs to be built to allow for train turnarounds (June 2013)	LA	С	4	06/13 TUN	GEN
212	UMS Inclined piles – 8" clearance between piles and tunnel results in damage or safety issues within the tunnel	RR	С	4		TUN
213	Micro Piles exist within tunnel path at UMS	RR	С	4		TUN
38	Tiebacks in Stockton Street misallocated (in path of walls and would have to be dug out within 20ft of surface level)'	MB	С	3	5/6/14 UMS1170	UMS
48	Incomplete drawdown of groundwater. (inside of box and inside of caverns)	QC	С	3	5/1/16 CTS1140	CTS
50	CTS station contractor delayed by tunnel contractor since station platform construction cannot start until tunnels have been finished.	MB	С	3	12/16/13 TUN1122	CTS
66	Archeological/Cultural findings during construction increases schedule and/or cost.(Moscone) AROUND 10%	QC	С	3	4/28/15 TUN1150	MOS
102	Late finish of early contract delays later contracts and extends PM / CM and incurs additional costs	AW	С	3	12/30/20 MS 0010	GEN
115	Jet grouted station end walls are installed by Tunnel contractor. Station Contractor assumes risk of possibly leakage problems due to insufficiently qualify of end walls.	SW	С	3	5/26/15 UMS1295	TUN
205	Prolong period of CMod's creates additional cost/causes bad blood between Resident Engineer and Contractor	ES/ RR	С	3		GEN
214	Micro Piles at UMS interfere with Tube-a-manchette installation (60' deep micropiles)	MB	С	3		TUN
J	Macy's entrance conflict with new piles	JW	С	3	1/23/14 UMS1060	UMS
PR37	Temporary construction power and ability to provide permanent power feed - PGE ability to provide power requirements to the program together with their other commitment	QC	С	3	5/3/18 STS1080	GEN
Q	As-built drawings and UMS construction drawings do not contain enough information to produce shop drawings without significant surveying effort delaying construction north	JW	С	3	3/24/12 UMS1280	UMS
v	TOD impact MOS and CTS construction contract.	RE	D	3	12/13/16 N-CTS1225	GEN

Design
Required
Market

Risk Register Rev 24a 1 8/12/2013

CENTRAL SUBWAY RISK SUMMARY

	SK SUMMARY	Diele	Biolo	Diele		
Risk#	Risk Description	Risk Owner	Risk Category	Risk Rating	Status	Contract
15	Major TBM machine failure	SW	С	2	2/5/14 TUN1124	TUN
33	Damage to utilities at UMS causes delay to construction and/or consequential cost. (very close to walls adjacent to relocated utility trenches)	JW	С	2	7/19/16 UMS1410	UMS
89	3rd Party reviews of Design documents delays completion of Final Design.	JW	D	2	5/23/12 FDS 1930	GEN
95	Contractor default during construction impacts schedule. (key sub-contractor)	AW	С	2	11/17/17 STS 1500	GEN
100	Procurement of long lead items delays work. (fans, rails and special track work, TPSS, Escalators, elevators, TBM)	JW	С	2	11/17/17 STS 1500	GEN
106	Risk of Labor dispute delaying the work.	RR	С	2	11/17/17 STS 1500	GEN
211	Differing site conditions encountered during ground freezing of Cross Passage 5 results in increased costs.	RR	С	2		TUN
215	DPW Excavation permit reviews delay contract works	AC	С	2		GEN
PR1	Actual TBM production rate may be slower than forecasted.	MB	С	2	2/5/14 TUN1124	TUN
PR78	Delays or complication by other SFMTA projects delays CSP: radio, fare collection, C3/TMC	MB	С	2	7/27/12 FDS 1940	STS
27	Loss of business results in unanticipated restrictions on construction at MOS.	BN	С	2	4/28/15 MOS1150	MOS
28	Incomplete cutoff of groundwater at UMS	JW	С	2	8/12/15 UMS1320	UMS
65	Archeological/Cultural findings during construction increases schedule and/or cost. (Portal) AROUND 10%	SW	С	2	10/24/12 TUN1080	TUN
103	Difficulty in getting required permits.	AC	С	2	12/18/12 FDS 1275	GEN
105	Electrical service delays startup and testing.	RR	С	2	11/17/17 STS 1500	GEN
216	Olivet building potential construction impact	MB	С	2	0.0.000	TUN
2a	42"/48" sewer line relocated as part Utility 1 package is damaged by subsequent construction of the launch box.	SW	С	2	10/24/12 TUN1080	TUN
PR80	ROW costs higher than anticipated.	AW	М	2	7/1/12 FDS 1240	GEN
5	Possibility that lowest level of tie-backs extending out from Moscone Center could be within the tunnel alignment.	SW	С	1	7/2/13 TUN1118	TUN
8	Flowing groundwater in vicinity of UMS Station could make adequate annulus grouting difficult.	SW	С	1	8/28/13 TUN1120	TUN
32	Delay in advanced utility relocation delays ground treatment and start of construction. (Utv 2)	JW	R	1	7/31/12 N-ATT00100	UMS
35	Ground support structure causes groundwater table to rise which results in leakage into adjacent structures.(new structure might create a dam that results into leaks into new	JW	С	1	9/7/16 UMS1430	UMS
37	Damage to adjacent buildings at UMS due to surface construction activities.	JW	С	1	9/7/16 UMS1430	UMS
71	Power supply interruptions to TBM's (no dual power feed currently planned)	RR	С	1	2/5/14 TUN1124	TUN
202	Cargo Preference (Ship America) must solicit U.S flag carriers. Civilian Agencies Cargo = at least 50% (governed by Cargo Preference Act of 1954	RR	С	1		SSTS
1	Additional night shift work required at portal launch box due to bus storage facility relocation delay	SW	С	1	3/20/15 TUN1160	TUN
U	Proximity at junction of head house boundary wall and school yard may result in relocation of school yard during wall construction	MB	С	1	8/16/13 CTS1010	CTS
13	Damage / settlement 3x 5' to old brick sewer running parallel to tunnel alignment	MF	С	1	12/16/13 TUN1121	TUN
21	Incomplete cutoff of groundwater at MOS	QC	С	1	4/28/15 MOS1150	MOS
22	Public complaints result in unanticipated restrictions on construction at MOS.	JW	С	1	9/16/16 MOS1230	MOS
36	Damage to buildings or utilities as a result of heave from jet grouting at UMS.	JW	С	1	4/14/15 UMS1310	UMS
79	Delay in obtaining tunnel easements (3 #) (goes to condemnation) - Costs of ROW may cost more than expected	AC	R	1	9/7/2012	TUN
PR83	Coordination with prime contractor could result in schedule impacts to others.	RE	С	1	0	GEN

CSP Risk Analysis Schedule - Rev 0

SP Risk An	alysis - Preliminary							Primavera Gantt
)	Description	Remaining Duration	Start	Finish	Minimum Duration	Most Likely	Maximum	2013 2014 2015 2016 2017 2018 2019
000 Headhou	Description use 1	349	16-Jan-14	05-Jun-15	262	349	Duration 436	J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
)10 Head ho		298	10-Mar-17	11-May-18	224	298	373	
020 Cross Cu		105	08-Jun-15	03-Nov-15	79	105	131	
030 Headhou		219			164	219	274	
			20-Jan-14	26-Nov-14				
040 Station F		432	19-Sep-14	10-Jun-16	324	432	540	
Northbou		319	16-Jun-16	19-Sep-17	239	319	399	
	uld Tunnel	319	16-Jun-16	19-Sep-17	239	319	399	
	CS & Startup		20-Sep-17	22-Mar-18	95	127	159	
080 Platform	Cavern South	128	30-Dec-15	30-Jun-16	96	128	160	
90 Platform	Cavern North	29	01-Jul-16	11-Aug-16	22	29	36	
100 Excavate	e & Support Crossover Cavern 206LF	163	18-Jul-16	09-Mar-17	122	163	204	
I10 Obtain P	ermits	62	29-Jul-13	23-Oct-13	47	62	78	
I20 Elevator	Final Design	184	20-Oct-14	16-Jul-15	138	184	230	
130 Excavate	e Headhouse to Temp Strut Level 1 & Install Strut	16	05-Aug-15	26-Aug-15	12	16	20	
I50 Headhou	ise - (Demo, Install Guide Walls, Excavate Surface Level Deck)	170	20-Jan-14	18-Sep-14	128	170	213	
	Environmental & Inplement Traffic Plan	90	04-Sep-13	15-Jan-14	68	90	113	
	tification/ Pre-Revenue Activities	115	12-Feb-18	26-Jul-18	86	115	144	
	g - Assemble Northbound TBM Shield	15	15-Jul-13	02-Aug-13	11	15	19	
	g - Test and Commission Northbound TBM	5	26-Aug-13	30-Aug-13		5	6	
	g - Launch Northbound TBM (163+52 - 160+00)	15	03-Sep-13	23-Sep-13	11	15	19	
		13	03-Sep-13	10-Oct-13		10	19	
	g - Tunnel Northbound (160+00 - 156+50)	0			17	00	0	
	g - Tunnel Northbound (156+50 - 142+30)	23	11-Oct-13	12-Nov-13	17	23	29	
	g - Tunnel Northbound (142+30 - 140+50)	3	13-Nov-13	15-Nov-13	2	3	4	
	g - Tunnel Northbound (140+50 - 135+00)	9	18-Nov-13	02-Dec-13	7	9	11	22-Nov-13
N-06 Tunnelir	ng - Tunnel Under Existing Bart Tunnels	0	22-Nov-13					22-Nov-13
N-06 Tunnelin	g - Tunnel Northbound (88+00 - 85+50)	5	25-Mar-14	31-Mar-14	4	5	6	
N-06 Tunnelin	g - Tunnel Northbound (85+50 - 81+20)	7	01-Apr-14	09-Apr-14	5	7	9	
N-06 Tunnelin	g - Tunnel Northbound (135+00 - 128+00)	11	03-Dec-13	17-Dec-13	8	11	14	
N-06 Tunnelin	g - Tunnel Northbound (103+00 - 88+00)	23	20-Feb-14	24-Mar-14	17	23	29	
N-06 Tunnelin	g - Tunnel Northbound (128+00 - 103+00)	41	18-Dec-13	19-Feb-14	31	41	51	
N-06 Tunnelin	g - Assemble Northbound TBM Trailing Gear	15	05-Aug-13	23-Aug-13	11	15	19	
N-06 Tunnelin	g - Tunnel Northbound (81+20 - 78+40)- to Pagoda	10	10-Apr-14	23-Apr-14	8	10	13	
	g - Test and Commission Southbound TBM	4	17-Jun-13	20-Jun-13	3	4	5	
	g - Launch Southbound TBM (163+52 - 160+00)	15	21-Jun-13	12-Jul-13	11	15	19	
	g - Install Tunnel Ventilation Ducts	1	24-Sep-13	24-Sep-13	"	1	1	
	g - Tunnel Southbound (160+00 - 156+50)	, , ,	25-Sep-13	02-Oct-13	5	, 6	۱ و	
	assage 2 - Excavate and Install Initial Support	15			11	15	19	
		10	24-Apr-14	14-May-14	"	15	19	
I	assage 2 - Construct Final Liner (Invert)	/	15-May-14	23-May-14	5	/	9	
	assage 2 - Construct Final Liner (Arch)	15	27-May-14	16-Jun-14	11	15	19	
	assage 4 - Excavate & Install Initial Support	15	17-Jun-14	08-Jul-14	11	15	19	
	assage 5 - Excavate & Install Initial Support (Cross Passage)	15	09-Jul-14	29-Jul-14	11	15	19	
	assage 5 - Construct Final Liner (Sump)	5	01-Aug-14	07-Aug-14	4	5	6	
N-11 Cross Pa	assage 5 - Install Misc Metals	1	08-Sep-14	08-Sep-14	1	1	1	
I-11 Cross Pa	assage 5 - Construct Final Liner (Invert)	5	08-Aug-14	14-Aug-14	4	5	6	
-11 Cross Pa	assage 5 - Construct Final Liner (Arch)	15	15-Aug-14	05-Sep-14	11	15	19	
-11 Cross Pa	assage 5 - Excavate & Install Initial Support (Sump)	2	30-Jul-14	31-Jul-14	2	2	3	
I-12 Portal St	ructure - Setup Traffic Control for Portal Structure (West)	1	09-Sep-14	09-Sep-14	1	1	1	
	ructure - Backfill & Prep for Base Slab	6	10-Sep-14	17-Sep-14	5	6	8	
	ructure - F/R/P Base Slab	12	18-Sep-14	03-Oct-14	9	12	15	
	ructure - F/R/P Lower Walls (to GL-3 & GL-8)	15	06-Oct-14	24-Oct-14	11	15	19	
	ructure - Construct Base Slab South of Launch Box (West)	7	17-Nov-14	25-Nov-14	5	7	a	
		'			الم	, , , , , , , , , , , , , , , , , , ,	9	
	ructure - Partial Backfill of Launch Box & Install Bracing	5	26-Nov-14	04-Dec-14	4	5	٥	
n-12 Portal St	ructure - Install Support Beam & Remove Decking (West)	4	05-Dec-14	10-Dec-14	3	4	5	

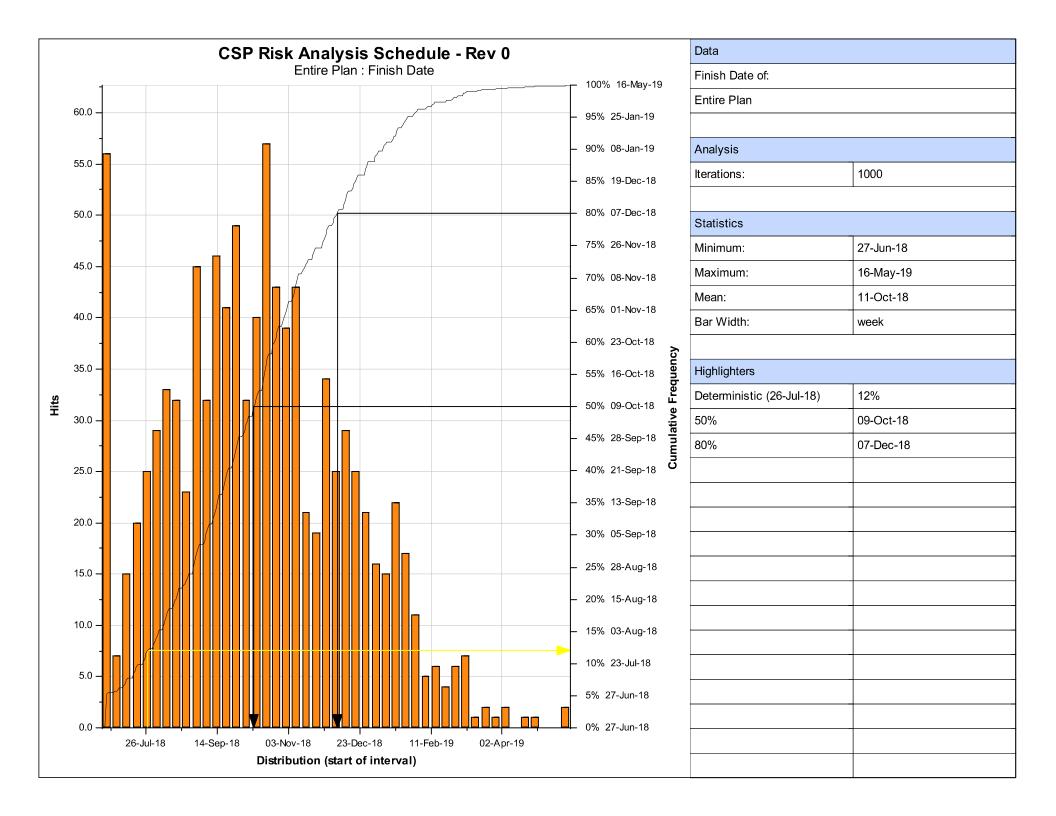
		Remaining			Minimum	Most	Maximum	201	13	2014	2015	2016	2017	2018	2019	Criticality
ID	Description	Duration	Start	Finish	Duration	Likely	Duration	DJF	МАМ	JJASONDJFMAMJJ	ASONDJFMAMJ	JASONDJFMAMJ	JASONDJFMAMJ	JASONDJFMAMJ	JASOND JFMAM.	Index
TUN-12	Portal Structure - Install Utilities (West)	15	05-Jan-15	23-Jan-15	11	15	19									100%
TUN-12	Portal Structure - Backfill Launch Box & Temp Restore (West)	7	26-Jan-15	03-Feb-15	5	7	9									100%
TUN-12	Portal Structure - Setup Traffic Control for Portal Structure (East)	1	04-Feb-15	04-Feb-15	1	1	1									100%
TUN-12	Portal Structure - SFWD Tie-in Utilities (East)	10	05-Feb-15	19-Feb-15	8	10	13									100%
TUN-12	Portal Structure - Remove Decking & Beams (East)	5	20-Feb-15	26-Feb-15	4	5	6									100%
TUN-12	Portal Structure - Construct Base Slab South of Launch Box (East)	6	24-Feb-15	03-Mar-15	5	6	8									100%
TUN-12	Portal Structure - F/R/P Upper Wall (East)	12	04-Mar-15	19-Mar-15	9	12	15									100%
TUN-12	Portal Structure - F/R/P Remaining Roof Slab	14	20-Mar-15	08-Apr-15	11	14	18									100%
TUN-12	Portal Structure - Backfill Launch Box and Remove Bracing	5	09-Apr-15	15-Apr-15	4	5	6									100%
TUN-12	Portal Structure - East Final Restoration (South of Perry)	10	09-Apr-15	22-Apr-15	8	10	13									100%
TUN-12	Portal Structure - SFWD Tie-in Utilities (West)	10	19-Jan-15	30-Jan-15	8	10	13									100%
TUN-12	Portal Structure - F/R/P Roof (to GL-3 & GL-8)	15	27-Oct-14	14-Nov-14	11	15	19									100%
TUN-12	Portal Structure - West Final Restoration	15	23-Apr-15	13-May-15	11	15	19									100%
TUN-13	Demobilization - Remove Contractor & Owner's Offices	20	14-May-15	11-Jun-15	15	20	25				<u> </u>					99%
TUN-13	Demobilization - Punchlist Activities	20	14-May-15	11-Jun-15	15	20	25									100%
TUN-13	Demobilization - Transfer Site to Subsequent Contractor(s)	1	11-Jun-15	11-Jun-15	1	1	1				Te	J				100%
TOT	ALS															

PRIMAVERA RISK ANALYSIS

Very Critical Start

Normal, Very Critical

	Company: JACOBS	Page 2 of 2	Sort: ACT-0D
	Manager:	Plan Finish: 26-Jul-18	Filter: CSP-torder
-			
_			
C	Planner: david Broussard	Date: 03AUG13	



CSP Risk Analysis Schedule - Rev 0 Schedule Sensitivity Index: Entire Plan - All tasks Definition of Schedule Sensitivity Index The schedule sensitivity index of a task is calculated by multiplying its criticality index by the ratio of its variance an Analysis Latin Hypercube Simulation 34% A1010 - Head house 2 **Iterations** 1000 A1040 - Station Platform 28% Calculation Values are calculated for: each task in the plan A1030 - Headhouse 24% Display Normal tasks only A1100 - Excavate & Support Crossover Cavern 206LF 18% Showing 10 highest values 0 Values greater than: A1000 - Headhouse 1 18% A1170 - Perform Environmental & Inplement Traffic Plan 15% 15% A1080 - Platform Cavern South A33333 - S&S Certification/ Pre-Revenue Activities 14% A1120 - Elevator Final Design 12% A1060 - Southbould Tunnel 11%

PROJECT	DICK DECICTED	sk Profile Severity Score			Low (1)	Medium (2)	High (3)	Very High (4)	Significant (5)	Legend		
		Score 1 2 3 4 5		Probability	< 10%	<> 10% - 50%	> 50%	<> 75% - 90%	> 90%	<3 Low	RISK RATING = PROBABILITY X (COST IMPACT + SCHEDULE IMPACT)	
	ay i roject darri randisco	5 H/CH		Cost Impact	< \$250K	<> \$250K - \$1M	<> \$1M - \$3M	<> \$3M - \$10M	> \$10M	3 - 9	2	
REV : 23		2 Kow		Schedule Impact	< 1 Month	⇔1 - 3 Months	<> 3 - 6 Months	⇔ 6 - 12 Months	> 12 Months	Medium	CCODE DODADILITY V (COCT IMPACT - CCLIEDLI E IMPACT)	
DATE ISSUE	D: 07/09/13			Schedule Impact	< 1 Month	<>1 - 3 Months	<> 3 - 6 Months	<> 6 - 12 Months	> 12 Months	>10 High	SCORE = PROBABILITY X (COST IMPACT + SCHEDULE IMPACT)	
Final Risk ID	Risk Description	Mitigation Description	Risk Category	Probability %	Cost Impact	Schedule Impact	Calc Impact	Calc %	Risk Rating	Score	Status	Must Complete by Date
Underground Tunn	el T											
I	Additional night shift work required at portal launch box due to bus storage facility relocation delay	Work with TJPA to coordinate construction schedules and GGB to coordinate Traffic Routing.	С	2	1	-	1	35%	1		No longer considered a risk. GGB not scheduled to be utilizing site until 2014	3/20/15 TUN1160
2a	42"/48" sewer line relocated as part Utility 1 package is damaged by subsequent construction of the launch box.	Make follow-on contractor responsible for repairs to any existing utility lines. Properly as built actual location as part of Utility 1 package and provide to Contract 3 Contractor	С	1	1	2	2	10%	2		Sewer Installation complete, awaiting as built drawing. Sewer installed according to contract drawings. Contract 1252 provisions for protection of existing utilities puts all cost and schedule risk on Contractor.	10/24/12 TUN1080
5	Possibility that lowest level of tie-backs extending out from Moscone Center could be within the tunnel alignment.	Lower tunnel alignment 5' below the lowest expected tieback. Include obstruction clause and allowance in contract documents.	С	1	1	1	1	10%	1		Contract Documents issued for bid, contain location of tiebacks from as built drawings, do not intersect tunnel alignment.	7/2/13 TUN1118
7	Potential for excessive settlement of BART tunnels - SIGNIFICANT COMPENSATION GROUT REQUIRED OVER ESTIMATE ALLOWANCES	 Early and extensive co-ordination with BART. Survey BART tunnels to determine exact locations. Checking effect of maximum expected settlement on tunnels. Require EPBM TBM, Contractor to demonstrate effective control of ground settlements and correction of settlements by compensation grouting, and pre-installation of compensation grout piping under BART tunnels prior to tunneling reaching Market St. Require repair/adjustment plan. Develop contingency plan to provide bus bridge, if needed. Require non-stop weekend excavation beneath BART tunnels. Monitor movement of BART tunnels in real-time. Repair/adjust as needed. Include probable cost in estimate. 	С	2	2	2	2	35%	4		Risk is considered active, with mitigation measures fully developed with the exception of Bus Bridge. Adjusted cost impact lower resulting in Risk rating increasing to 2 but still remains a low risk.	8/28/13 TUN1120
8	Flowing groundwater in vicinity of UMS Station could make adequate annulus grouting difficult.	Use appropriate additives such as accelerators in primary annulus backfill grouting, if needed. Use secondary grouting as needed.	С	1	1	1	1	10%	1		2 Plans issued for bid contain mitigation measures	8/28/13 TUN1120
E	Underground obstructions tunnel and retrieval shaft	Include differing site conditions in GPs as well as DRB to adjudicate conflicts and minimize costs	С	2	2	3	3	35%	5		Mitigation measures have been implemented. 10 Maintain adequate contingency throughout tunnel construction	2/5/14 TUN1124
PR1	Actual TBM production rate may be slower than forecasted.	Assign significant liquidated damages for not meeting specific schedule dates.	С	1	1	3	2	10%	2		Considered Risk inherent in the work and reflected in the Current Cost Estimate. Risk will be reflected in Contractor's Bid. LDs included in contract.	2/5/14 TUN1124
13	Damage / settlement 3x 5' to old brick sewer running parallel to tunnel alignment	Slip Line 3'x5' brick sewer before TBM reaches CTS.	С	1	1	-	1	10%	1		Tunnel profile has been lowered 25 ft. and plans 1 developed for replacement of at risk utilities in advance of tunnel drive.	12/16/13 TUN1121
15	Major TBM machine failure	Closely monitor condition and maintenance of the machines.	С	1	2	2	2	10%	2		Contractor has indicated that they plan to use a newly manufactured TBM for this project.	2/5/14 TUN1124
16	TBM loss and / or damaged in Transit	Provide provisions for insurance for TBM in transit to jobsite	С	1	5	4	5	10%	5		9 Costs covered by Contractor's insurance.	5/20/13 TUN1095
115	Jet grouted station end walls are installed by Tunnel contractor. Station Contractor assumes risk of possibly leakage problems due to insufficiently qualify of end walls.	In the 1252 contract, have tunnel contractor set aside a pre-determined amount of money in escrow that can be used to repair any leaks encountered by the station contractors after the in the jet grout end walls are excavated. Alternatively, place an allowance in the station contracts for end wall leakage repair.	С	3	1	1	1	50%	3		Project configuration changes include headwall designs with multiple levels of redundancy. Warranty provisions added to contact language.	5/26/15 UMS1295
116	TBM procurement, delivery and assembly takes longer than assumed in schedule.	Accommodate delay to TBM procurement and delivery, on the order of 2 or 3 months, with current float shown on the construction schedule.	С	2	2	2	2	35%	4		8 Mitigation measures are being implemented	5/20/13 TUN1095

PROJECT	RISK REGISTER	Risk Profile Severity Score			Low (1)	Medium (2)	High (3)	Very High (4)	Significant (5)	Legend		
	ay Project San Francisco	Score 1 2 3 4 5		Probability	< 10%	<> 10% - 50%	> 50%	<> 75% - 90%	> 90%	<3 Low	RISK RATING = PROBABILITY X (COST IMPACT + SCHEDULE IMPACT)	
REV : 23	ay i roject Gairi randisco	5 H/GH		Cost Impact	< \$250K	<> \$250K - \$1M	<> \$1M - \$3M	<> \$3M - \$10M	> \$10M	3 - 9	2	
		2 Com Page		Schedule Impact	< 1 Month	⇔1 - 3 Months	<> 3 - 6 Months		> 12 Months	Medium >10	SCORE = PROBABILITY X (COST IMPACT + SCHEDULE IMPACT)	
DATE ISSUE	D: 07/09/13			Schedule Impact	< 1 Month	S 1 - 3 Months	<> 3 - 6 MONTHS	♦ 6 - 12 MONTHS	> 12 Months	>10 High	SCORE = PROBABILITY A (COST IMPACT + SCHEDULE IMPACT)	
Final Risk ID	Risk Description	Mitigation Description	Risk Category	Probability %	Cost Impact	Schedule Impact	Calc Impact	Calc %	Risk Rating	Score	Status Comp	Must plete by Date
В	Storage and testing of excavated soils from tunnel limits advance rate of tunneling.	 Provide adequate storage and handling facility to accommodate testing activity. Work with SAR to develop acceptance criteria, to minimize or eliminate testing requirements. Require the contractor to provide a detailed workplan for testing, sorting and stockpile prior to hauling. 	С	2	3	3	3	35%	6	9		/5/14 N1124
MOS Station		Require additional grouting to limit leakage to permissible level.			_			122/			Mitigation measure to be made part of the contract 4/2	28/15
	Incomplete cutoff of groundwater at MOS	Include probable grouting work in cost & schedule estimates.	С	1	1	-	1	10%	1	1	,	OS1150
22	Public complaints result in unanticipated restrictions on construction at MOS.	 Public outreach. Maintain regular and open communications so Public knows construction plans and progress at all times. Require Contractor to assist Public Outreach efforts, maintain access to businesses and assist with deliveries and pick-ups, control noise and vibration, continuously cleanup site, and provide pedestrian and vehicle traffic and protection plans, informational signage, ADA ramps and minimum sidewalk widths. Work with MOED to increase cleanup of the area and assist pedestrians across streets, as needed. Monitor and enforce noise, vibration, ADA, traffic, and cleanup requirements. Quickly process and resolve damage and accident claims from the Public. Assumed this work in cost & schedule estimates. 	С	1	1	-	1	10%	1	1		/16/16 OS1230
F	Underground obstructions Stations (MOS)	 Provide adequate allowance for differing site conditions to address unknown underground obstructions. Show field verified obstructions discovered during previous contracts on contract drawings. Make as-built drawings of structures adjacent to the work available to the contractor as reference drawings. 	С	4	2	2	2	80%	8	16		28/15 OS1150
27	Loss of business results in unanticipated restrictions on construction at MOS.	1. Public outreach. 2. Maintain regular and open communications so Merchants know construction plans and progress at all times. 3. Require Contractor to coordinate with merchants, maintain access to businesses and assist with deliveries and pick-ups, continuously cleanup site, and provide pedestrian and vehicle traffic and protection plans, informational signage, and minimum sidewalk widths. 4. Require barriers to protect pedestrians and shield them from noise and dirt from construction. 5. Work with MOEWD to increase cleanup of the area and assist pedestrians across streets. 6. Include this work in cost & schedule estimates.	С	1	2	1	2	10%	2	3		28/15 OS1150
F	Underground obstructions Stations (UMS)	 Provide adequate allowance for differing site conditions to address unknown underground obstructions. Show field verified obstructions discovered during previous contracts on contract drawings. Make as-built drawings of structures adjacent to the work available to the contractor as reference drawings. 	С	4	2	2	2	80%	8	16	Multigation measures have been implemented	/12/15 IS 1320
28	Incomplete cutoff of groundwater at UMS	If needed, perform grouting to mitigate the intrusion of groundwater. Include in cost & schedule estimates.	С	1	2	1	2	10%	2	3		/12/15 IS1320

PROJECT	DISK DECISTED	sk Profile Severity Score			Low (1)	Medium (2)	High (3)	Very High (4)	Significant (5)	Legend		
	<u>-</u>	Score 1 2 3 4 5		Probability	< 10%	<> 10% - 50%	> 50%	<> 75% - 90%	> 90%	<3	RISK RATING = PROBABILITY X (COST IMPACT + SCHEDULE IMPACT)	
REV : 23	ay Project San Francisco	4 M/SOM		Cost Impact	< \$250K	<> \$250K - \$1M	<> \$1M - \$3M	<> \$3M - \$10M	> \$10M	3 - 9 Medium	2	
DATE ISSUE	D: 07/09/13	2 CON		Schedule Impact	< 1 Month	⇔ 1 - 3 Months	<> 3 - 6 Months	<> 6 - 12 Months	> 12 Months	>10 High	SCORE = PROBABILITY X (COST IMPACT + SCHEDULE IMPACT)	
Final Risk ID	Risk Description	Mitigation Description	Risk Category	Probability %	Cost Impact	Schedule Impact	Calc Impact	Calc %	Risk Rating	Score	Status	Must Complete by Date
32	Delay in advanced utility relocation delays ground treatment and start of construction. (Uty 2)	Intensive coordination with and commitment from utility owners. Early completion incentive for utility relocation contract. Enforce franchise agreements.	R	1	1	1	1	10%	1		Advance utility relocation contract (1251) is underway with a projected completion date in advance of advertising UMS construction contract, reducing this risk of cost and schedule impacts	7/31/12 N-ATT00100
33	Damage to utilities at UMS causes delay to construction and/or consequential cost. (very close to walls adjacent to relocated utility trenches)	Intensive utility coordination and investigation. Relocate utilities out of the way of construction wherever possible. Show utilities on reference plans. Have utility contact information and procedure on plans. Have contingency repair/restoration plans. Include probable impacts to schedule & cost in estimates.	С	2	1	1	1	35%	2		Although mitigation measure have been fully implemented, Increased probability due to proximity of new pile design to existing relocated utilities.	7/19/16 UMS1410
34	Loss of business results in unanticipated	1. Public outreach. 2. Work closely with Merchant's Association. 3. Maintain regular and open communications so Merchants know construction plans and progress at all times. 4. Advertise that Stockton Street Merchants are Open for Business. 5. Require Contractor to coordinate with merchants, maintain access to businesses and assist with deliveries and pick-ups, continuously cleanup site, and provide pedestrian and vehicle traffic and protection plans, informational signage, and minimum sidewalk widths. 6. Require barriers to protect pedestrians and shield them from noise and dirt from construction. 7. Work with the Union Square BID or MOED to increase cleanup of the area and assist pedestrians across streets. 8. Include this work in cost & schedule estimates.	С	2	3	2	3	35%	5	1	Mitigation measures to be implemented and to the extent possible requirements will be written into contract documents to minimize disruptions to businesses.	9/7/16 UMS1430
35	Ground support structure causes groundwater table to rise which results in leakage into adjacent structures.(new structure might create a dam that results into leaks into new and existing structures)	Perform detailed hydrogeologic modeling and analysis. Monitor groundwater table at multiple locations and passive measures as necessary to mitigate. Reference the Tech memo in contract documents. Include probable costs in estimate.	С	1	2	-	1	10%	1		2 Mitigation measures incorporated in design based on updated Hydrogeologic analysis and report	9/7/16 UMS1430
36	Damage to buildings or utilities as a result of heave from jet grouting at UMS.	Utilize tangent piles combined with surface jet grouting.	С	1	1	-	1	10%	1		1 Mitigation measures implemented in contract documents to reduce risk	4/14/15 UMS1310
37	Damage to adjacent buildings at UMS due to surface construction activities.	Require protective barriers. Have an emergency and rapid response customer focused task force to fix damaged facilities. Quickly repair and reimburse resulting costs. Include probable cost in estimate.	С	1	2	-	1	10%	1		2 Mitigation measures implemented in contract documents to reduce risk	9/7/16 UMS1430
38		Direct contractor to dig out the tiebacks on the plans. Include allowance and differing site conditions clause in contract. Include this work in the cost and schedule estimates.	С	2	2	1	2	35%	3		Mitigation measures fully implemented, Advance utility relocation contract (1251) confirmed location of tiebacks. Risk rating has been reduced due to a lowering of the probability of event occurring	5/6/14 UMS1170

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PROJECT	RISK REGISTER	sk Profile kelihood Severity Score			Low (1)	Medium (2)	High (3)	Very High (4)	Significant (5)	Legend		
Central Subw	ay Project San Francisco	Score 1 2 3 4 5 5		Probability	< 10%	<> 10% - 50%	> 50%	<> 75% - 90%	> 90%	<3 Low	RISK RATING = PROBABILITY X (COST IMPACT + SCHEDULE IMPACT)	
REV : 23		4 MEON		Cost Impact	< \$250K	<> \$250K - \$1M	<> \$1M - \$3M	<> \$3M - \$10M	> \$10M	3 - 9 Medium	2	
DATE ISSUE	D: 07/09/13			Schedule Impact	< 1 Month	<> 1 - 3 Months	<> 3 - 6 Months	<> 6 - 12 Months	> 12 Months	>10 High	SCORE = PROBABILITY X (COST IMPACT + SCHEDULE IMPACT)	
Final Risk ID	Risk Description	Mitigation Description	Risk Category	Probability %	Cost Impact	Schedule Impact	Calc Impact	Calc %	Risk Rating	Score	Status	Must Complete by Date
J	Macy's entrance conflict with new piles	Show known obstructions shown on as-built drawings on contract drawings. Make as-built drawings available to contractor as reference drawings. Have contractor field verify obstruction shown on as-built drawings and contract drawings	С	3	1	1	1	50%	3		Known obstructions are shown on the ES drawings. 6 Allowance for differing site conditions added to UMS Station contract.	1/23/14 UMS1060
Q	As-built drawings and UMS construction drawings do not contain enough information to produce shop drawings without significant surveying effort delaying construction north entrance.	Investigate if electronic files of design can be given to the contractor. Clearly define shop drawing criteria in the technical specifications. Make as-built drawings available as reference drawings to the contractor.	С	3	1	1	1	50%	3		6 Specifications require contractor to survey USG in order to develop shop drawings for structural steel.	3/24/12 UMS1280
CTS Station		1.5.0										
46	Public complaints result in unanticipated restrictions on construction at CTS. (schedule and estimate for underground work assumes 6 day work week and 2 shifts per day)	 Public outreach. Maintain regular and open communications so Public knows construction plans and progress at all times. Require Contractor to assist Public Outreach efforts, maintain access to businesses and assist with deliveries and pick-ups, control noise and vibration, continuously cleanup site, and provide pedestrian and vehicle traffic and protection plans, informational signage, ADA ramps and minimum sidewalk widths. Require barriers to protect pedestrians and shield them from noise and dirt from construction. Work with MOED to increase cleanup of the area and assist pedestrians across streets, as needed. Monitor and enforce noise, vibration, ADA, traffic, and cleanup requirements. Quickly process and resolve damage and accident claims from the Public. Include this work in cost & schedule estimates. 	С	2	5	1	3	35%	6		Implementation of mitigation measures part of Communication/Outreach plan and certain aspects to be included in the contract documents.	10/9/17 CTS1500
48	Incomplete drawdown of groundwater. (inside of box and inside of caverns)	Require additional grouting to limit leakage to permissible level. Include probable grouting work in cost & schedule estimates. Include allowance for dewatering within cavern during construction.	С	2	2	1	2	35%	3		6 Mitigation measures have been included in contract documents	5/1/16 CTS1140
50	CTS station contractor delayed by tunnel contractor since station platform construction cannot start until tunnels have been finished.	Include provisions in CTS contract identifying the potential waiting period for tunnel contractor. Actively monitor progress towards schedule milestones	С	2	1	2	2	35%	3		6 Constraints on CTS contractor added to specification "Work Sequence and Constraints"	12/16/13 TUN1122
52	Unacceptable settlement and impact on major utilities at CTS. (OLD SEWERS AND OTHERS WITHIN 20FT SPACE BETWEEN TOP OF CAVERN AND STREET LEVEL)	1. Evaluate effect of potential settlement on utilities. 2. Slip-line sewer by TBM contractor. 3. Reinforce other utilities as needed, monitored during construction, and repair / replace, as needed. 4. Have contingency repair/restoration plan. 5. Utility contact information and procedure will be on plans. 6. Develop an allowance for utility repair. 7. Include probable cost in estimate.	С	3	3	1	2	50%	6		Project configuration change, lowered station 25 ft. 12 reducing the probability of this risk. Risk rating lowered.	4/22/16 N-CTS9730
F	Underground obstructions stations (CTS)	Provide adequate allowance for differing site conditions to address unknown underground obstructions. Make as-built drawings of structures adjacent to the work available to the contractor as reference drawings	С	4	2	2	2	80%	8		16 Mitigation measures have been implemented.	10/9/17 CTS1500
U	Proximity at junction of head house boundary wall and school yard may result in relocation of school yard during wall construction		С	1	1	1	1	10%	1		Project configuration changed to eliminate encroachment. Risk converted to Construction risk from Risk 55.	8/16/13 CTS1010
General Demolition, Clearing	Farthwork											
Site Utilities, Utility												

KISK Kegiste						N4 - 11	117.1	V	0::			
PROJECT	RISK REGISTER	Severity Severity			(1)	Medium (2)	High (3)	Very High (4)	Significant (5)	Legend		
Central Subw	ay Project San Francisco			Probability	< 10%	<> 10% - 50%	> 50%	<> 75% - 90%	> 90%	<3 Low	RISK RATING = PROBABILITY X (COST IMPACT + SCHEDULE IMPACT)	
REV : 23	-	5 A A A B B B B B B B B B B B B B B B B		Cost Impact	< \$250K	<> \$250K - \$1M	<> \$1M - \$3M	<> \$3M - \$10M	> \$10M	3 - 9 Medium	2	
		2 Com										
DATE ISSUE	D: 07/09/13	1		Schedule Impact	< 1 Month	<> 1 - 3 Months	<> 3 - 6 Months	<> 6 - 12 Months	> 12 Months	>10 High	SCORE = PROBABILITY X (COST IMPACT + SCHEDULE IMPACT)	
Final Risk ID	Risk Description	Mitigation Description	Risk Category	Probability %	Cost Impact	Schedule Impact	Calc Impact	Calc %	Risk Rating	Score	Status	Must Complete by Date
Hazmat, Contamin	l ated Material											
Environmental Miti												
65	Archeological/Cultural findings during construction increases schedule and/or cost. (Portal) AROUND 10%	Provide on-call Archeologist. Provide allowance and procedure in contract for Archeological/Cultural discoveries.	С	1	2	1	2	10%	2	3	Additional boring taken in vicinity of portal indicated no evidence of Archeological/Cultural resources.	10/24/12 TUN1080
66	Archeological/Cultural findings during construction increases schedule and/or cost.(Moscone) AROUND 10%	Provide on-call Archeologist. Provide allowance and procedure in contract for Archeological/Cultural discoveries.	С	3	1	1	1	50%	3	6	Mitigated - Current exposure only to those amount above those currently identified	4/28/15 TUN1150
67	Archeological/Cultural findings during construction increases schedule and/or cost. (UMS)LESS THAN 1%	Provide on-call Archeologist. Provide allowance and procedure in contract for Archeological/Cultural discoveries.	С	3	1	2	2	50%	5	9	Mitigation measures to be implemented in contract documents	8/12/15 UMS1320
68	Archeological/Cultural findings during construction increases schedule and/or cost. (CHINA TOWN)AROUND 10%	Provide on-call Archeologist. Provide allowance and procedure in contract for Archeological/Cultural discoveries.	С	3	1	2	2	50%	5	9	Mitigation measures to be implemented in contract documents	10/9/17 CTS1500
Auto/bus/van acce	ss ways, roads											
70	Change in traffic control requirements after bid.	 Provide unit bid items to reimburse contractor for traffic management costs outside their control. Include allowance in construction contracts for PCOs. 	С	3	4	1	3	50%	8	15	Mitigation measures implemented.	5/22/17 STS1020
71	Power supply interruptions to TBM's (no dual power feed currently planned)	Obtain TBM power directly from PG&E substation.	С	1	2	-	1	10%	1	2		2/5/14 TUN1124
Train Control and S	ignals		T									
72	Interface new Signaling and Train Control system to existing at Fourth and King	Connect new system in parallel with existing system until the new system has been tested and safety certified for operation.	С	2	2	3	3	35%	5	10	Awaiting approval of contract plans by Muni Operations.	3/4/16 STS1045
PR78	Delays or complication by other SFMTA projects delays CSP: radio, fare collection, C3/TMC	Monitor other projects' developments. Develop contingency plans as needed to avoid 1256 delay of revenue service.	С	2	1	1	1	35%	2	4	ı	7/27/12 FDS 1940
Traffic signals & Cr Purchase or lease			•				•					
79	Delay in obtaining tunnel easements (3 #) (goes										Right of possession obtained on all three parcels.	
, ,	to condemnation) - Costs of ROW may cost more than expected	Engage Owners in negotiations as soon as possible. PM/CM to provide real estate specialists to facilitate.	R	1	1	-	1	10%	1	1	Cost agreement reached with 1455 Stockton & 801 Market.	9/7/2012
PR80	ROW costs higher than anticipated.	Provide adequate contingency for potential higher costs	M	1	3	-	2	10%	2	3	Similar to Risk 81.	7/1/12 FDS 1240
Reloc. of Househol	d or Business											
Vehicles												
83	Cost of vehicles may be more than estimated due to sole source and small order	Time the procurement of the vehicles to be part of the procurement of the existing Breda LRVs.	R	3	4	1	3	50%	8	15	CSP vehicles to be included in overall SFMTA vehicle procurement contract.	11/17/17 STS 1500
Preliminary Engine	ering											
80												E /02 /40
Droin at Marrara	3rd Party reviews of Design documents delays completion of Final Design.	Provide assistance to 3rd Parties to facilitate their reviews and obtain concurrent partial approval for underground work.	D	1	2	2	2	10%	2	4	3rd Party coordination meeting ongoing.	5/23/12 FDS 1930
95	nt for Design and Construction											11/17/17
93	Contractor default during construction impacts schedule. (key sub-contractor)	Assist Bonding company in transition and to maintain schedule.	С	1	2	2	2	10%	2	4		STS 1500
99	Breakdown in relationships between SFMTA and Contractors during construction results in increased claims and delays to the overall construction schedule.	Executive partnering and alternate dispute resolution. Provide incentives in construction contracts in addition to penalties	С	2	5	3	4	35%	8	16	Mitigation measures being implemented	7/27/12 FDS 1940

RISK Registe					Low	Medium	Lliah	Von High	Cignificant	Logond		
PROJECT	RISK REGISTER	K Profile			(1)	(2)	High (3)	Very High (4)	Significant (5)	Legend		
Central Subw	ay Project San Francisco	5 4/0		Probability	< 10%	<> 10% - 50%	> 50%	<> 75% - 90%	> 90%	<3 Low	RISK RATING = PROBABILITY X (COST IMPACT + SCHEDULE IMPACT)	
REV : 23		3		Cost Impact	< \$250K	<> \$250K - \$1M	<> \$1M - \$3M	<> \$3M - \$10M	> \$10M	3 - 9 Medium	2	
DATE ISSUE		2 COW		Schedule Impact	< 1 Month	⇔ 1 - 3 Months	<> 3 - 6 Months	<> 6 - 12 Months	> 12 Months	>10	SCORE = PROBABILITY X (COST IMPACT + SCHEDULE IMPACT)	
DATE ISSUE	D: 07/09/13									High		
Final Risk ID	Risk Description	Mitigation Description	Risk Category	Probability %	Cost Impact	Schedule Impact	Calc Impact	Calc %	Risk Rating	Score	Status	Must Complete by Date
100		Include schedule milestones for procurement of and substantial payment for stored long lead items in contract to encourage early procurement. Monitor procurement of critical items.	С	1	2	2	2	10%	2	4	Not considered a project risk.	11/17/17 STS 1500
102	Late finish of early contract delays later contracts and extends PM / CM and incurs additional costs	Actively manage contracts and include incentive provisions for early completion in critical contracts. Add buffer float to critical path to actively manage schedule contingency	С	2	1	2	2	35%	3	6	LONP 1 & 2 initiated to reduce this risk. See Risk 86. The mitigation of risks associated with early contracts will address this risk. Risk rating reduced due to mitigation measures implemented	12/30/20 MS 0010
Т	Delay on station emergency ventilation approval	Work with SFFD to develop a plan acceptable to each party. Incorporate SFFD requirements into construction documents.	R	2	5	-	3	35%	5	10	SFFD agreed to the proposed plan by SFMTA	7/27/12 FDS 1940
V	·	Participate and provide input of CSP constraints to SFMTA Real Estate during process of initial task to define best use. Integrate work with SFMTA Real Estate into CSP.	D	2	1	2	2	35%	3	6		12/13/16 N-CTS1225
PR37	Temporary construction power and ability to provide permanent power feed - PGE ability to provide power requirements to the program together with their other commitment	Identify temporary power requirements for station construction. Investigate the timing of the permanent feed.	С	2	1	2	2	35%	3	6	Cost for First and Redundant electrical services need to be included in Cost Estimate.	5/3/18 STS1080
Insurance, permits	etc.											
103	Difficulty in getting required permits.	Coordinate with permit officials and request permits as early as possible. Obtain assistance obtaining permits from PM/CM & FD Consultants.	С	1	2	1	2	10%	2	3	:	12/18/12 FDS 1275
104		Obtain Grade Crossing approvals at final CPUC inspection at the completion of construction. Coordinate closely with CPUC until approval is received.	R	2	3	2	3	35%	5	10	Providing preview of 90% submittal to CPUC and will resolve comments/issues from PE before finalizing design documents	7/27/12 FDS 1940
105	, ,	Submit applications for new service as early as possible. Coordinate closely with PG&E to ensure timely delivery of electrical service.	С	1	2	1	2	10%	2	3	Applications for new service have been submitted to PG&E.	11/17/17 STS 1500
106		Enforce designated gate for employees of the contract in dispute so that the rest of the work is not delayed.	С	2	1	1	1	35%	2	4		11/17/17 STS 1500
Unallocated Contin	gency											
111	Major Earthquake stops work	Include Force Majeure clause in contracts.	С	1	5	3	4	10%	4	8	Force Majeure clause included in contracts.	12/30/20 MS 0010
112		Require contractor Safety plan to address this risk. CM inspections to ensure that safety plan and procedures are implemented.	С	1	5	3	4	10%	4	8	Health and Safety provisions included in contracts. CS Program provides full-time Safety Manager.	12/30/20 MS 0010
100								l				
196		Continue to negotiate with building owners Required Notices and Appraisals to be completed Commence condemnation process with City Attorneys	С		1	1	1	0%	4	-		
202	Cargo Preference (Ship America) must solicit U.S flag carriers. Civilian Agencies Cargo = at least 50% (governed by Cargo Preference Act of 1954	Require Ship America compliance agreement first tier contractors and subcontractors	С	1	1	1	1	10%	1			
203	Headwalls interface delay 1300 Contractor	Meet and develop recovery schedule Review possible Adjustment to 1300 interface	С	3	3	2	3	50%	8	15		

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PROJECT	T DICK DECICTED	Risk Profile			Low (1)	Medium (2)	High (3)	Very High (4)	Significant (5)	Legend		
Central Subw	vay Project San Francisco			Probability	< 10%	<> 10% - 50%	> 50%	<> 75% - 90%	> 90%	<3 Low	RISK RATING = PROBABILITY X (COST IMPACT + SCHEDULE IMPACT)	
REV : 23	, ,	5 4 1/6 _H		Cost Impact	< \$250K	<> \$250K - \$1M	<> \$1M - \$3M	<> \$3M - \$10M	> \$10M	3 - 9 Medium	2	
DATE ISSUE	ED: 07/09/13	2 COW TOWN		Schedule Impact	< 1 Month	⇔ 1 - 3 Months	<> 3 - 6 Months	<> 6 - 12 Months	> 12 Months	>10 High	SCORE = PROBABILITY X (COST IMPACT + SCHEDULE IMPACT)	
Final Risk ID	Risk Description	Mitigation Description	Risk Category	Probability %	Cost Impact	Schedule Impact	Calc Impact	Calc %	Risk Rating	Score	Status	Must Complete by Date
204	AT&T Vault - New Sewer Work south of Bryant	Continue negotiations/coordination with utility owners. Schedule analysis to confirm coordination	С	2	2	4	3	35%	6	12		
205	Prolong period of CMod's creates additional cost/causes bad blood between Resident Engineer and Contractor	CMod Task Force - 5 Areas of Improvement Implement Delegation of Authority	С	3	1	1	1	50%	3	6		
208	Additional cost if we change direction going to the Pagoda	Develop Scope with designers currently under contract Agree to alignment and details of new shaft location Issue PCC to Contractor Initial site works and borings if necessary Obtain appropriate permits	С	3	3	2	3	50%	8	15		
210	Mission Bay Loop Grant – Needs to be built to allow for train turnarounds (June 2013)	Identify timeline for grant funding	С	4	1	1	1	80%	4	8		
211	Differing site conditions encountered during ground freezing of Cross Passage 5 results in increased costs.		С	1	2	2	2	10%	2	4		
212	UMS Inclined piles – 8" clearance between piles and tunnel results in damage or safety issues within the tunnel	S acceptable tolerances Workshop to be held with BIH to discuss	С	1	5	3	4	10%	4	8		
213	Micro Piles exist within tunnel path at UMS	Re-profile and realign tunnel to clear micropiles	С	2	3	1	2	35%	4	8		
214	Micro Piles at UMS interfere with Tube-a- manchette installation (60' deep micropiles)	Provide micro-pile as-built information to contractor Realign tube-a-manchettes clear of micro-piles	С	3	1	1	1	50%	3	6		
215	DPW Excavation permit reviews delay contract works	Obtain a blanket excavation permits from DPW covering the area of work for 1253, 1254, 1255, 1256	С	2	1	1	1	35%	2	4		
216	Olivet building potential construction impact	Reach out to building owner and keep him abreast of CS construction activities.	С	1	1	2	2	10%	2	3		
217	Delays or complications construction by others SF Dept. Of Technology, 3rd party utilities	 1. Early engagement and coordination for agreements and plan development to avoid construction delays. 	С	2	1	1	1	35%	2	4	DTIS MOU has been signed.	