



Prepared for:
**Agency
District**

Project Name

City, XX

CSRA for 2022 Current Working Estimate (CWE)



Prepared by:

Agency

Cost Engineering Technical Center of Expertise, Walla Walla, WA

October 2022

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1. Purpose

The Agency, District, presents this Cost and Schedule Risk Analysis (CSRA) report regarding the risk findings and recommended contingencies for the Project Name 2022 Current Working Estimate (CWE). A *Monte-Carlo* based risk analysis was conducted by the Project Delivery Team (PDT) on remaining costs in compliance with UFC 3-740-05, Construction Cost Estimating. The purpose of this risk analysis study is to present the cost and schedule risks considered and respective project contingencies at a recommended 50% confidence level of successful execution to project completion.

2. Project Scope

Recommend providing a brief summary of the project location, background, major scope items, assumed contract acquisition strategy, etc.

3. Key Assumptions

Recommend documenting key assumptions regarding the analysis. Some common examples are:

- **Funding.** Are there funding limitations or potential delays in acquiring funding?
- **Sponsor.** Is there a sponsor involved? Do their capabilities impact funding on when work can be performed if activities need to be completed by the sponsor?
- **Contract Acquisition Strategy.** How many contracts will there be to execute the project?
- **Construction vs. Total Project.** Is the CSRA evaluating just construction or the total project which could include real estate, design, engineering during construction, construction management, etc.? This sometimes varies based on what was requested.
- **Contingency Sources.** Sometimes contingencies are provided to the cost engineer and not varied in the CSRA. Example, real estate contingencies on many USACE projects are provided by the Real Estate Community of Practice (CoP). Still recommend evaluating the schedule risks for these items since it could increase risk to other project components.
- **Geotechnical.** Have investigative drilling or studies been conducted which support the design? If this data is not currently available, it could drastically impact scope, cost, and schedule if it varies much from the current assumptions.
- **Hydraulics & Hydrology.** Has hydraulic modeling or studies been conducted which support the design? If this data is not currently available, it could drastically impact scope, cost, and schedule if it varies much from the current assumptions.
- **Surveying/Mapping.** Does recent survey or mapping data support quantity development?
- **Construction Schedule.** Has a construction schedule been developed that factors in weather days, work calendars, holidays, winter shutdown periods, work window restrictions, constraints, lead-times, non-construction activities, etc. which could impact the implementation schedule?

4. Cost & Schedule Risk Analysis Process

Refer to Chapter 14 of the UFC 3-740-05, Construction Cost Estimating, which details out the overview, responsibilities, documentation, process, review, market analysis, risk register, modeling, and deliverables required in developing the CSRA.

5. Base Estimate

See Appendix A for a summary of the base cost estimate from which this CSRA was conducted.

6. Base Schedule

See Appendix B for a summary of the base schedule from which this CSRA was conducted.

7. Cost & Schedule Risk Analysis

The CSRA results are provided in the following sections. In addition to contingency calculation results, the top cost and schedule risks were identified, and sensitivity analyses are presented to provide decision makers with:

- An understanding of variability and the key contributors,
- Contingency information for scheduling, budgeting, and project control purposes, and
- Provide tools to support decision making and risk management as projects progress through planning and implementation.

Additional information and details can be found in various Appendix C subsections which are described below.

- **Appendix C-1: Risk Dashboards.** Summary of the top cost & schedule risk items, confidence levels, and suggested risk reduction measures.
- **Appendix C-2: Contingency Summary.** Summary of the various contingency values for cost & schedule by confidence level.
- **Appendix C-3: Sensitivity Charts.** Summary of the major cost & schedule risk items along with a graphical representation of their potential range of impacts at the 50%, 80%, and 90% confidence levels.
- **Appendix C-4: Risk Register.** Summary of the risk register documenting risk type, risk details, likelihood, impact ratings, responsibility, suggested risk reduction measures, etc.
- **Appendix C-5: CSRA Assumptions.** Summary of the risk matrix, likelihood of occurrence definition, impact or consequence definitions for cost / schedule, and cost / schedule impact ranges as they relate to this project.
- **Appendix C-6: Risk Register Attendance.** Summary of the participants of the risk register meeting which was conducted on 10/1/2022.
- **Appendix C-7: Risk Details (if applicable).** Some projects and their risk items could require more complex calculations to determine their risk impact ranges. This is not a mandatory requirement, but risk detail sheets are sometimes developed to help document these assumptions and calculations. These risk detail sheets are typically not included by default but can be available upon request.

7.1. Summary of Results

The **current remaining construction cost** is approximately **\$297.9M** excluding contingency and expressed in **FY2023** dollars. Based on the results of the analysis, the CSRA recommends a contingency value of **\$83.4M**, or approximately **28%** of base project cost at an 50% confidence level of successful execution. The current project base construction schedule is approximately **65** months excluding contingency. Based on the results of the analysis, the CSRA recommends a contingency value of almost **8.4** months, or approximately **13%** of base project schedule at an 50% confidence level of successful execution. See Table 1 below for a more detailed summary and Appendix C for additional details regarding risk-based contingency development.

Table 1. Summary of CSRA Results

Contingency on Base Estimate		50% Confidence Project Cost	
	Base Estimate	\$297,942,392	
	Estimate Contingency	\$83,423,870	28%
	Base Estimate w/ Contingency (50% Confidence)	\$381,366,262	

Contingency on Base Schedule		50% Confidence Project Schedule	
	Base Schedule Start Date	October 1, 2021	
	Base Schedule Finish Date	March 1, 2027	
	Base Schedule Duration	65.0 Months	
	Schedule Contingency Duration	8.4 Months	13%
	Base Schedule w/ Contingency (50% Confidence)	73.4 Months	
	Base Finish Date w/ Contingency (50% Confidence)	November 15, 2027	

7.2. Cost Risk Analysis

7.2.1. Cost Confidence Levels

The result of risk or uncertainty analysis is quantification of the cumulative impact of all analyzed risks or uncertainties as compared to probability of occurrence. These results, as applied to the analysis herein, depict the overall project cost at intervals of confidence (probability). Table 2 provides the cost contingencies calculated for the various confidence levels with the 50% confidence level highlighted. Figure 1 presents this information graphically. Contingencies are rounded up to the nearest whole percentage.

Table 2. Cost Confidence Levels

Base Estimate		\$297,942,392	
Confidence Level	Contingency Value	Contingency	Cost with Contingency
0%	-\$35,753,087	-12%	\$262,189,305
10%	\$35,753,087	12%	\$333,695,479
20%	\$50,650,207	17%	\$348,592,599
30%	\$62,567,902	21%	\$360,510,295
40%	\$74,485,598	25%	\$372,427,990
50%	\$83,423,870	28%	\$381,366,262
60%	\$92,362,142	31%	\$390,304,534
70%	\$104,279,837	35%	\$402,222,230
80%	\$116,197,533	39%	\$414,139,925
90%	\$134,074,077	45%	\$432,016,469
100%	\$220,477,370	74%	\$518,419,763

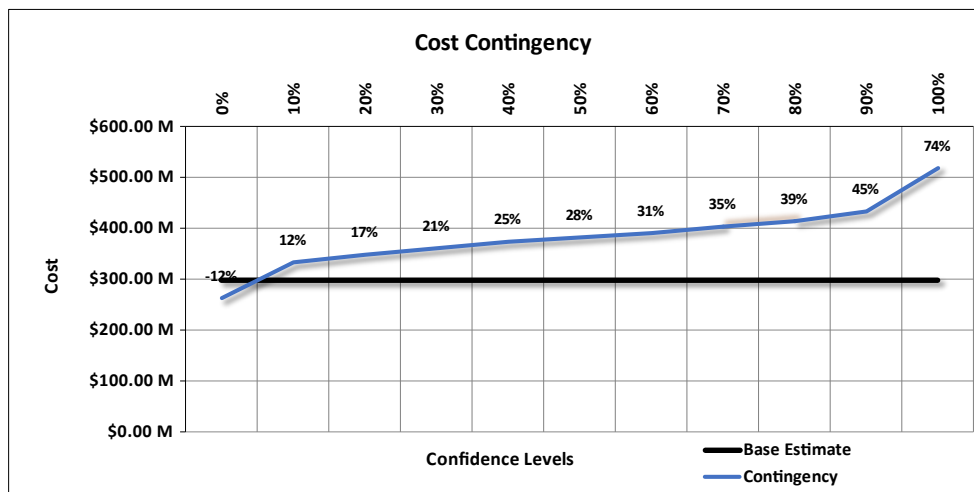


Figure 1. Cost Contingency Levels

7.2.2. Top Cost Risks

The risks/opportunities considered as key or primary cost drivers are ranked in order of potential impact (positive or negative) in Figure 2 at various confidence levels (50%, 80%, and 90%). Opportunities that have a potential to reduce project cost and are shown with a negative sign to reflect the potential to decrease project cost; risks are shown with a positive sign to reflect the potential to increase project cost. These key cost drivers can be used to support development of a risk management plan that will facilitate control of risk factors and their potential impacts throughout the project lifecycle. Together with the risk register, these results can also be used to support development of strategies to eliminate, mitigate, accept, or transfer key risks. See Appendix C for additional details for these risks and further information regarding CSRA development.

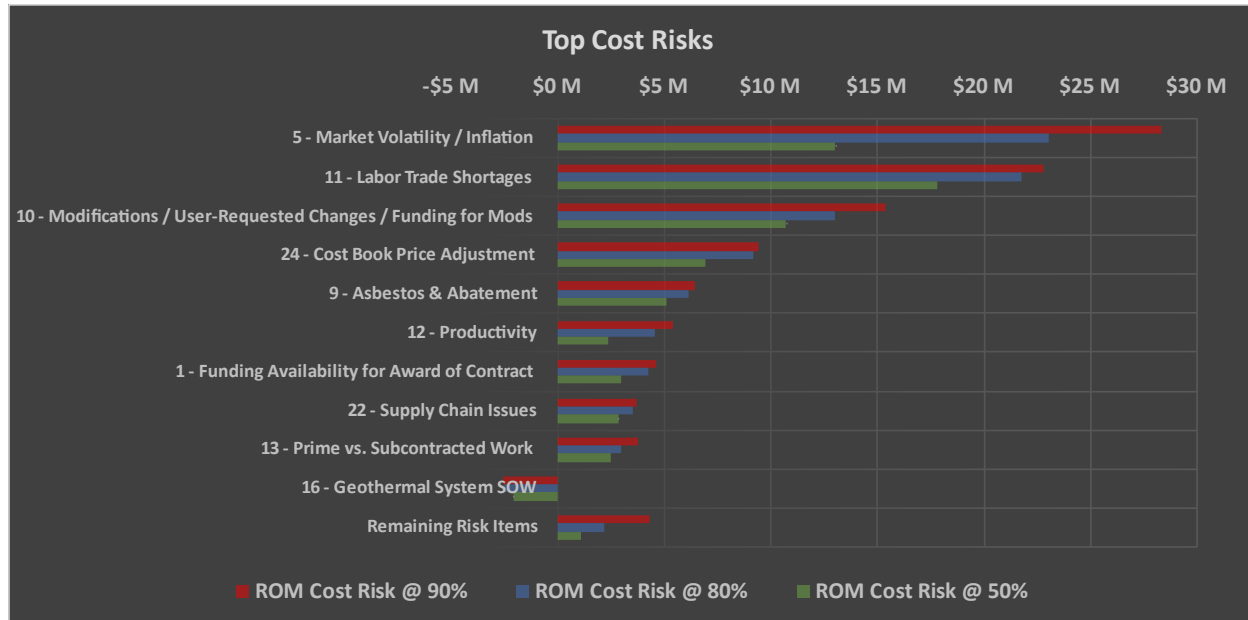


Figure 2. Top Cost Risks

- Risk 5: Market Volatility / Inflation.** Escalation percentages to get to midpoint of construction; there is a lot of volatility in the market right now. The current future projection has inflation at approximately 3% per year but the latest ENR Building Cost Index 3-year trend is about 7.2% for the Denver, CO area.
- Risk 11: Labor Trade Shortages.** Primarily related to roofers, concrete, and electricians but it depends on how much work is taking place in Denver. There could be additional labor costs for per diem or productivity impacts if not enough trade is available to achieve the higher production rates.
- Risk 10: Modifications / User-Requested Changes / Funding for Mods.** Modifications exist on every project. The availability of funding and time it takes to receive funding for change orders could also impact the cost and schedule as well.
- Risk 24: Cost Book Price Adjustment.** The estimate is heavily based on the 2016 Cost Book for which material pricing has to be adjusted. Building materials since COVID hit have been very volatile with pricing.
- Risk 9: Asbestos & Abatement.** Full abatement is currently not included in the estimate or schedule. Doing demolition and investigation early on in construction can help identify what work could be anticipated. If full abatement is needed, it could affect cost and schedule.
- Risk 12: Productivity.** This could be impacted by availability of trade workers as mentioned in Risk 11. The base estimate assumes 70% productivity factor which is typical for renovation work. Because construction is in an occupied building, there are certain restrictions which would impact productivity.
- Risk 1: Funding Availability for Award of Contract.** The DD1391 is currently based on the original 65% cost estimate but the CSRA process has resulted in an updated estimate which is

higher. The intent is to update the DD1391 with the most current estimate projections. Another concern is that there is currently no funding for modifications which are very likely to occur. If approval of the current DD1391 does not happen before the award date, it could delay the project by a year.

- **Risk 22: Supply Chain Issues.** Longer lead times could affect cost or schedule. Many long lead items already identified in schedule which drive the construction duration. Shortening the lead time may cost more due to having to pay premiums.
- **Risk 13: Prime vs. Subcontracted Work.** If the Prime Contractor is outside the area, sometimes they have trouble getting subcontractors to work with them. What work is performed by the Prime Contractor or Subcontractors can also vary along with the associated indirect markups (Field Office, Home Office, Profit, & Bond).
- **Risk 16: Geothermal System SOW.** The base schedule assumes two rigs with 6 months to install and is on the critical path. If multiple drilling rigs cannot be acquired to install the system, it could possibly increase the critical path to the construction schedule.

7.3. Schedule Risk Analysis

7.3.1. Schedule Confidence Levels

The result of risk or uncertainty analysis is quantification of the cumulative impact of all analyzed risks or uncertainties as compared to probability of occurrence. These results, as applied to the analysis herein, depict the overall project duration at intervals of confidence (probability). Table 3 provides the schedule duration contingencies calculated for the various confidence levels with the 50% confidence level highlighted. Contingencies are rounded up to the nearest whole percentage.

Table 3. Schedule Confidence Levels

Base Schedule Duration		65.0 Months	
Confidence Level	Contingency Value	Contingency	Duration with Contingency
0%	-12.3 Months	-19%	52.6 Months
10%	1.3 Months	2%	66.3 Months
20%	3.2 Months	5%	68.2 Months
30%	5.2 Months	8%	70.2 Months
40%	7.1 Months	11%	72.1 Months
50%	8.4 Months	13%	73.4 Months
60%	10.4 Months	16%	75.4 Months
70%	12.3 Months	19%	77.3 Months
80%	14.9 Months	23%	79.9 Months
90%	17.5 Months	27%	82.5 Months
100%	31.8 Months	49%	96.8 Months

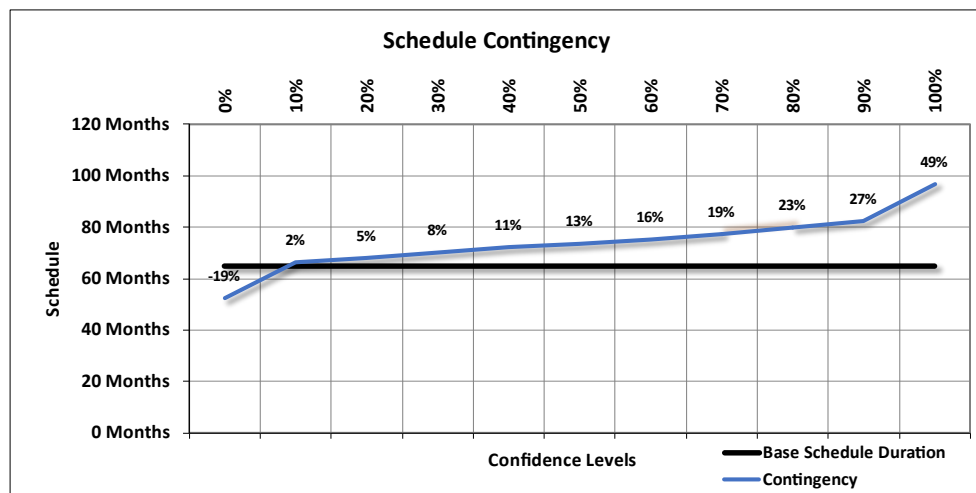


Figure 3. Schedule Contingency Levels

These contingencies were also used to calculate the projected residual fixed cost impact of project delays that are included in the Table 2 presentation of total cost contingency. The schedule contingencies were calculated by applying the high-level schedule risks identified in the risk register for each option to the durations of critical path and near critical path tasks.

The schedule was not resource loaded and contained open-ended tasks and non-zero lags (gaps in the logic between tasks) that limit the overall utility of the schedule risk analysis. These issues should be considered as limitations in the utility of the schedule contingency data presented. Schedule contingency impacts presented in this analysis are based solely on projected residual fixed costs.

7.3.2. Top Schedule Risks

The risks/opportunities considered as key or primary schedule drivers are ranked in order of potential impact (positive or negative) in Figure 4 at various confidence levels (50%, 80%, and 90%). Opportunities that have a potential to reduce project schedule and are shown with a negative sign to reflect the potential to decrease project duration; risks are shown with a positive sign to reflect the potential to increase project duration. These key schedule drivers can be used to support development of a risk management plan that will facilitate control of risk factors and their potential impacts throughout the project lifecycle. Together with the risk register, sensitivity analysis results can also be used to support development of strategies to eliminate, mitigate, accept, or transfer key risks. See Appendix C for additional details for these risks and further information regarding CSRA development.

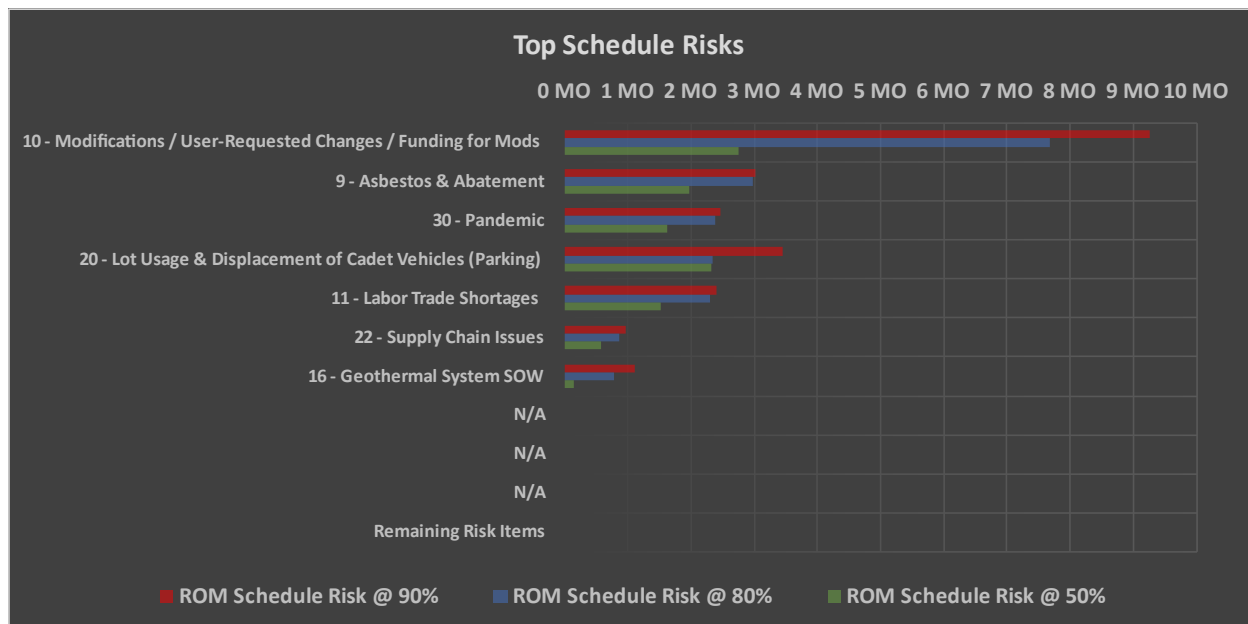


Figure 4. Top Schedule Risks

- **Risk 10: Modifications / User-Requested Changes / Funding for Mods.** Modifications exist on every project. The availability of funding and time it takes to receive funding for change orders could also impact the cost and schedule as well.
- **Risk 9: Asbestos & Abatement.** Full abatement is currently not included in the estimate or schedule. Doing demolition and investigation early on in construction can help identify what work could be anticipated. If full abatement is needed, it could affect cost and schedule.
- **Risk 30: Pandemic.** Pandemic outbreaks could cause delays to construction or availability of materials.
- **Risk 20: Lot Usage & Displacement of Cadet Vehicles (Parking).** If the location of lay down areas or there are changes in assumptions related to how the existing lots are going to be used for contractor access, this could affect cost or schedule related to additional work which may be needed for other laydown areas or the number of productive working hours in a day if the contractor has to stage employees further away.

- **Risk 11: Labor Trade Shortages.** Primarily related to roofers, concrete, and electricians but it depends on how much work is taking place in Denver. There could be additional labor costs for per diem or productivity impacts if not enough trade is available to achieve the higher production rates.
- **Risk 22: Supply Chain Issues.** Longer lead times could affect cost or schedule. Many long lead items already identified in schedule which drive the construction duration. Shortening the lead time may cost more due to having to pay premiums.
- **Risk 16: Geothermal System SOW.** The base schedule assumes two rigs with 6 months to install and is on the critical path. If multiple drilling rigs cannot be acquired to install the system, it could possibly increase the critical path to the construction schedule.

8. Recommendations, Risk Management, & Updates

8.1. Recommendations

Risk Management is an all-encompassing, iterative, and life-cycle process of project management. The Project Management Institute's (PMI) *A Guide to the Project Management Body of Knowledge (PMBOK® Guide), Sixth Edition*, states that "project risk management includes the processes of conducting risk management planning, identification, analysis, response planning, response implementation, and monitoring risk on a project." Risk identification and analysis are processes within the knowledge area of risk management. Its outputs pertinent to this effort include the risk register, risk quantification (risk analysis model), contingency report, and the sensitivity analysis.

The intended use of these outputs is implementation by the project leadership with respect to risk responses (such as mitigation) and risk monitoring and control. In short, the effectiveness of the project risk management effort requires that the proactive management of risks not conclude with the study completed in this report.

The CSRA produced by the PDT identifies issues that require the development of subsequent risk response and mitigation plans. This section provides a list of recommendations for continued management of the risks identified and analyzed in this study. Note that this list is not all inclusive and should not substitute a formal risk management and response plan.

The CSRA study serves as a "road map" towards project improvements and reduced risks over time. The PDT should include the recommended cost and schedule contingencies and incorporate risk monitoring and mitigation on those identified risks. Further iterative study and update of the risk analysis throughout the project life cycle is important in support of remaining within an approved budget and appropriation.

8.2. Risk Management

Project leadership should use of the outputs created during the risk analysis effort as tools in future risk management processes. The risk register should be updated at each major project milestone. The results of the sensitivity analysis may also be used for response planning strategy and development. These tools should be used in conjunction with regular risk review meetings.

8.3. Risk Analysis Updates

Project leadership should review risk items identified in the original risk register and add others, as required, throughout the project life cycle. Risks should be reviewed for status and reevaluation (using qualitative measure, at a minimum) and placed on risk management watch lists if any risk's likelihood or impact significantly increases. Project leadership should also be mindful of the potential for secondary (new risks created specifically by the response to an original risk) and residual risks (risks that remain and have unintended impact following response).

Appendix A

Base Estimate

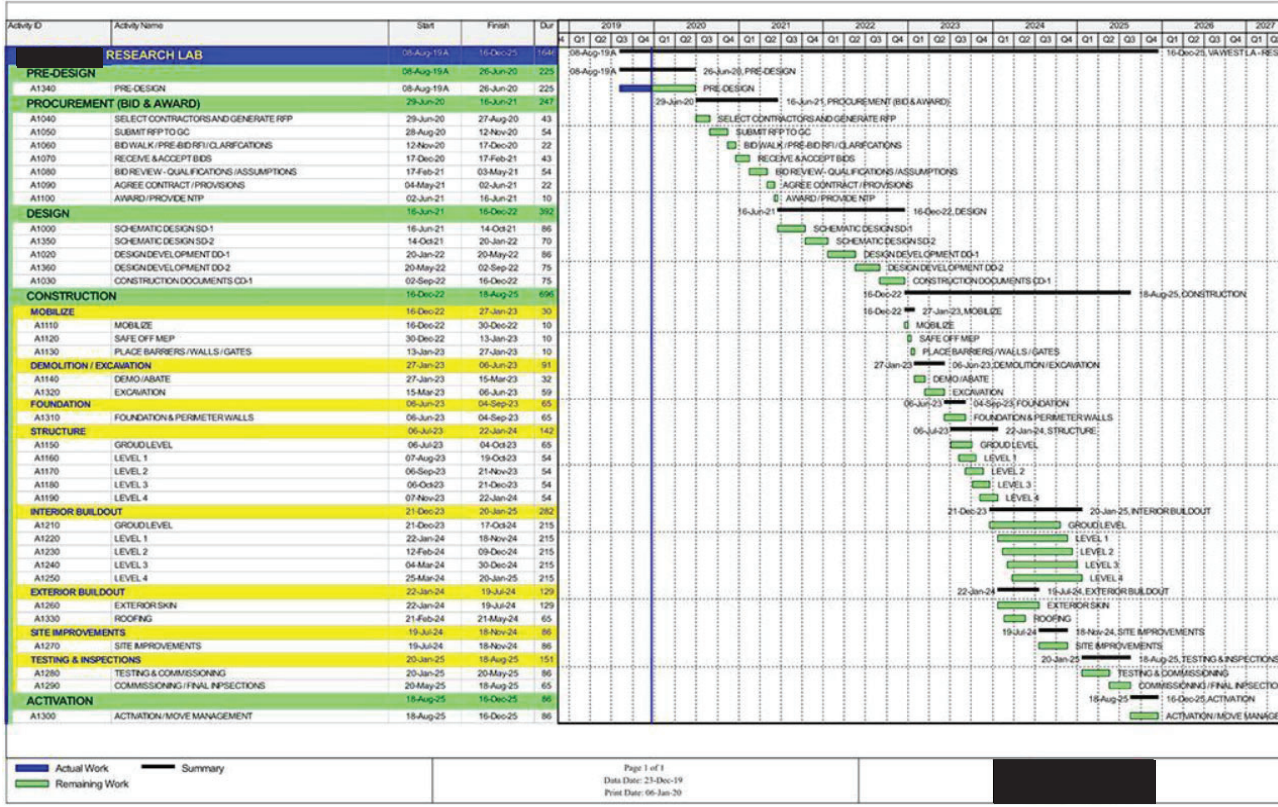
Primary Facilities	\$7,517,206.38	\$5,231,828.18	\$136,204.46	\$493,153.73	\$13,378,392.75
	Material	Labor	Equipment	SubBid	Total
Physics Lab	\$7,188,316.63	\$5,131,724.48	\$106,062.44	\$493,153.73	\$12,919,257.28
A SUBSTRUCTURE	\$324,405.59	\$367,912.13	\$43,897.60	\$0.00	\$736,215.32
B SHELL	\$2,182,463.67	\$934,253.72	\$39,412.13	\$0.00	\$3,156,129.52
C INTERIORS	\$342,554.16	\$314,830.62	\$1,554.87	\$0.00	\$658,939.65
D SERVICES	\$3,899,490.91	\$3,151,601.68	\$6,626.92	\$489,490.53	\$7,547,210.04
E EQUIPMENT & FURNISHINGS	\$151,249.28	\$58,386.08	\$103.39	\$0.00	\$209,738.75
F SPECIAL CONSTRUCTION & DEMOLITION	\$120,043.52	\$209,071.83	\$6,871.05	\$0.00	\$335,986.40
G BUILDING SITEWORK	\$168,109.50	\$95,668.42	\$7,596.48	\$3,663.20	\$275,037.60
Apron	\$141,755.69	\$49,010.98	\$12,793.13	\$0.00	\$203,559.80
A SUBSTRUCTURE	\$21,594.64	\$2,587.95	\$0.00	\$0.00	\$24,182.59
G BUILDING SITEWORK	\$120,161.05	\$46,423.03	\$12,793.13	\$0.00	\$179,377.21
Towway	\$187,134.06	\$51,092.72	\$17,348.89	\$0.00	\$255,575.67
A SUBSTRUCTURE	\$47,627.28	\$5,707.77	\$0.00	\$0.00	\$53,335.05
G BUILDING SITEWORK	\$139,506.78	\$45,384.95	\$17,348.89	\$0.00	\$202,240.62
Supporting Facilities	\$601,769.92	\$553,639.32	\$94,208.58	\$0.00	\$1,249,617.82
Clear and Grub	\$16,887.57	\$72,195.01	\$32,766.56	\$0.00	\$121,849.14
F SPECIAL CONSTRUCTION & DEMOLITION	\$0.00	\$13,650.49	\$2,223.80	\$0.00	\$15,874.29
G BUILDING SITEWORK	\$16,887.57	\$58,544.52	\$30,542.76	\$0.00	\$105,974.85
Communications	\$199,433.10	\$221,424.90	\$9,113.48	\$0.00	\$429,971.48
G BUILDING SITEWORK	\$199,433.10	\$221,424.90	\$9,113.48	\$0.00	\$429,971.48
Excavation, Cut and Fill	\$3,598.22	\$21,781.79	\$25,695.59	\$0.00	\$51,075.60
G BUILDING SITEWORK	\$3,598.22	\$21,781.79	\$25,695.59	\$0.00	\$51,075.60
Parking Lots (Advanced)	\$124,284.53	\$70,173.87	\$17,773.38	\$0.00	\$212,231.78
G BUILDING SITEWORK	\$124,284.53	\$70,173.87	\$17,773.38	\$0.00	\$212,231.78
Storm Sewer	\$31,708.15	\$35,225.80	\$916.31	\$0.00	\$67,850.26
G BUILDING SITEWORK	\$31,708.15	\$35,225.80	\$916.31	\$0.00	\$67,850.26
Underground Electrical Distribution (Advanced)	\$73,424.81	\$38,789.07	\$2,572.83	\$0.00	\$114,786.71
A SUBSTRUCTURE	\$756.21	\$1,001.76	\$434.07	\$0.00	\$2,192.04
D SERVICES	\$11,913.10	\$8,916.93	\$0.00	\$0.00	\$20,830.03
G BUILDING SITEWORK	\$60,755.50	\$28,870.38	\$2,138.76	\$0.00	\$91,764.64
Water Distribution (Advanced)	\$152,433.54	\$94,048.88	\$5,370.43	\$0.00	\$251,852.85
D SERVICES	\$7,363.29	\$5,543.09	\$0.00	\$0.00	\$12,906.38
G BUILDING SITEWORK	145070.25	\$88,505.79	\$5,370.43	\$0.00	\$238,946.47
In-Project Lump Sum(s)					\$16,261,889.00
Antiterrorism Measures AT FP					\$53,000.00
Anechoic Chamber					\$13,015,787.00
Bridge Crane					\$472,943.00
Clean Agent					\$2,720,159.00
Miscellaneous					\$0.00
Pavement					\$0.00
Site Improvements					\$0.00
Utilities					\$0.00
Total Construction Costs	\$8,118,976	\$5,785,468	\$230,413	\$493,154	\$30,889,900
Summary by WBS					
A SUBSTRUCTURE	\$815,925.00				
B SHELL	\$3,156,129.52				
C INTERIORS	\$658,939.65				
D SERVICES	\$7,580,946.45				
E EQUIPMENT & FURNISHINGS	\$209,738.75				
F SPECIAL CONSTRUCTION & DEMOLITION	\$351,860.69				
G BUILDING SITEWORK	\$1,854,470.51				
In-Project Lump Sum(s)	\$16,261,889.00				
Miscellaneous	\$0.00				
TOTAL	\$30,889,899.57				

Appendix B

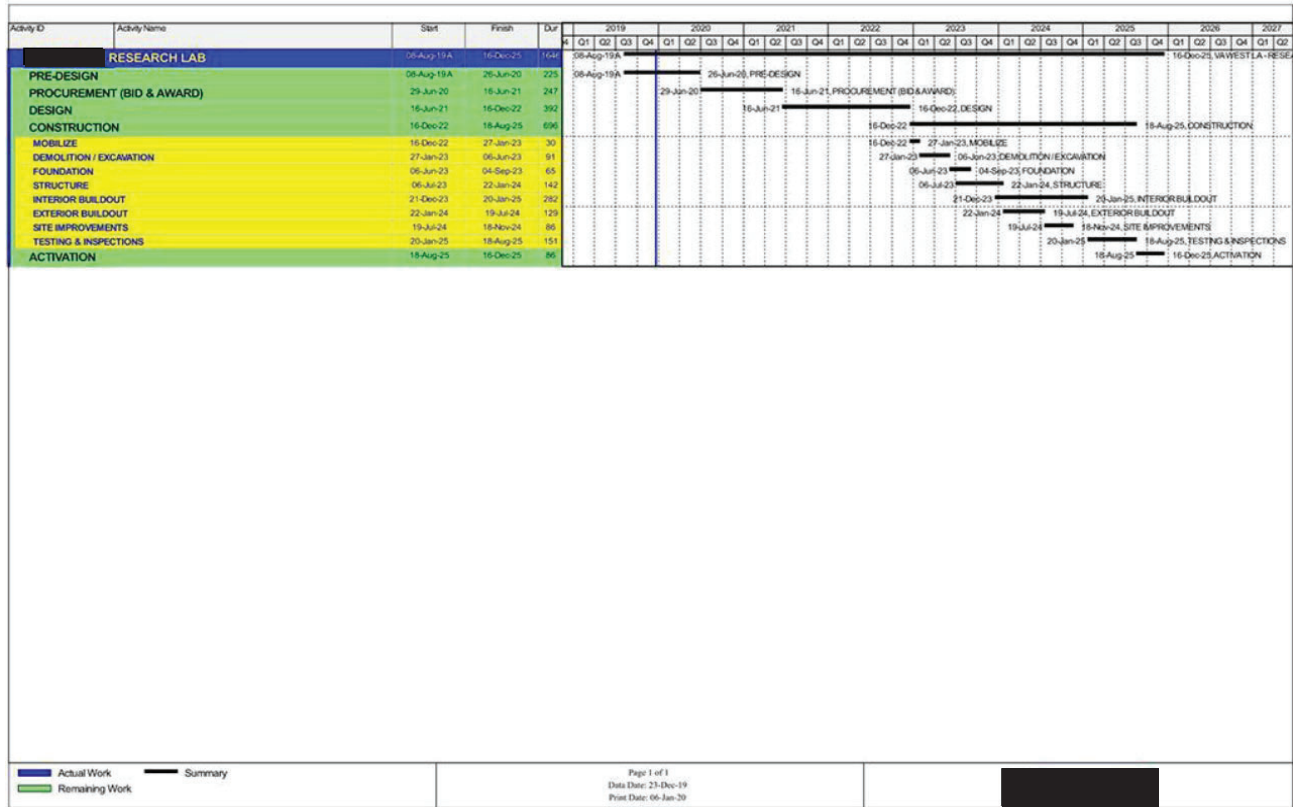
Base Schedule

Schedule Summary

Contract	Cost	Duration	Start	Finish	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	FY29	Notes
Research Building		1,796 d	1-Jan-23	1-Dec-27											4.91 YR
<u>Research Building</u>			1-Jan-23	1-Dec-27											4.91 YR
Remaining Design (Design-Bid-Build)		547 d	1-Jan-23	1-Jul-24											1.50 YR
Waiting on Construction Funding		123 d	1-Jul-24	1-Nov-24											0.34 YR
Procurement (RTA to NTP)		365 d	1-Nov-24	1-Nov-25											1.00 YR
Construction (Future Contract)	\$75.12 M	760 d	1-Nov-25	1-Dec-27											2.08 YR
Schedule Contingency		435 d	2-Dec-27	8-Feb-29											1.19 YR



Schedule Summary



Appendix C

Cost & Schedule Risk Analysis Details

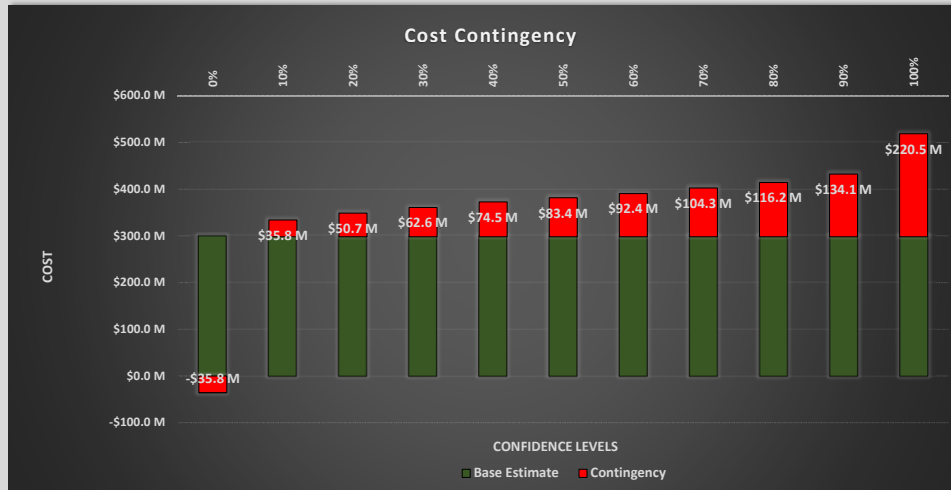
Appendix C-1

Risk Dashboards

Cost Risk Dashboard

Project: Project Name
 Location: Walla Walla, WA

Contingency on Base Estimate	50% Confidence Project Cost	
	Base Estimate	\$297,942,392
	Estimate Contingency	\$83,423,870 28%
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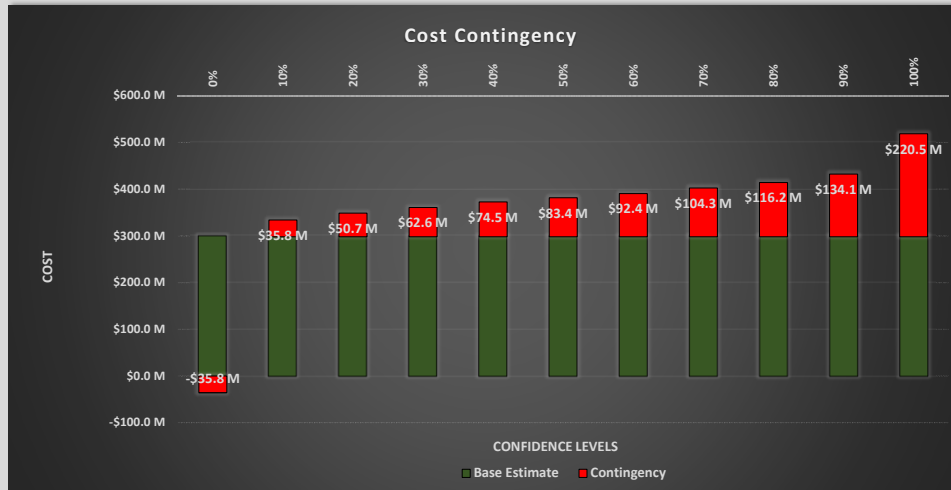
TOP COST RISKS

Risk/Opportunity Event	Risk Event Description	PDT Discussions on Impact and Likelihood	Responsibility/ POC	Risk Level		Suggested Risk Reduction Measures (Avoid, Escalate, Exploit, Transfer/Share, Mitigate/Enhance, or Accept)
				Cost	Schedule	
5	Market Volatility / Inflation	~Choosing escalation percentages to get to midpoint of construction. ~ A lot of volatility in the market right now.	Cost Engineering	High	Low	Need PDT input on risk reduction measures.
11	Labor Trade Shortages	Primarily related to roofers, concrete, and electricians. ~ Depends on how much work is taking place in Denver ~ Could be additional labor costs for per diem, etc. ~ Could impact productivity assumptions as well if not enough trade is available to achieve the higher production rates.	Cost Engineering	High	High	Need PDT input on risk reduction measures.
10	Modifications / User- Requested Changes / Funding for Mods	~Modifications exist on every project. ~ Availability of funding / time it takes to receive funding for change orders could also impact cost/schedule as well.	Project Management	High	High	Need PDT input on risk reduction measures.
24	Cost Book Price Adjustment	~The estimate is heavily based on the 2016 Cost Book for which material pricing has to be adjusted. ~Building materials since COVID hit have been very volatile with pricing.	Cost Engineering	Medium	Low	Need PDT input on risk reduction measures.
9	Asbestos & Abatement	Full abatement is currently not included in the estimate or schedule. Doing demolition and investigation early on in construction can help identify what work could be anticipated. Changes in the current assumptions could affect cost/schedule.	Environmental Compliance	High	High	Need PDT input on risk reduction measures.
12	Productivity	~ Could be impacted by availability of trade workers as mentioned in risk item 11. ~ Base estimate assumes 70% productivity factor for renovation work.	Cost Engineering	High	High	Need PDT input on risk reduction measures.

Cost Risk Dashboard

Project: Project Name
 Location: Walla Walla, WA

Contingency on Base Estimate	50% Confidence Project Cost	
Base Estimate	\$297,942,392	
Estimate Contingency	\$83,423,870	28%
Base Estimate w/ Contingency (50% Confidence)	\$381,366,262	



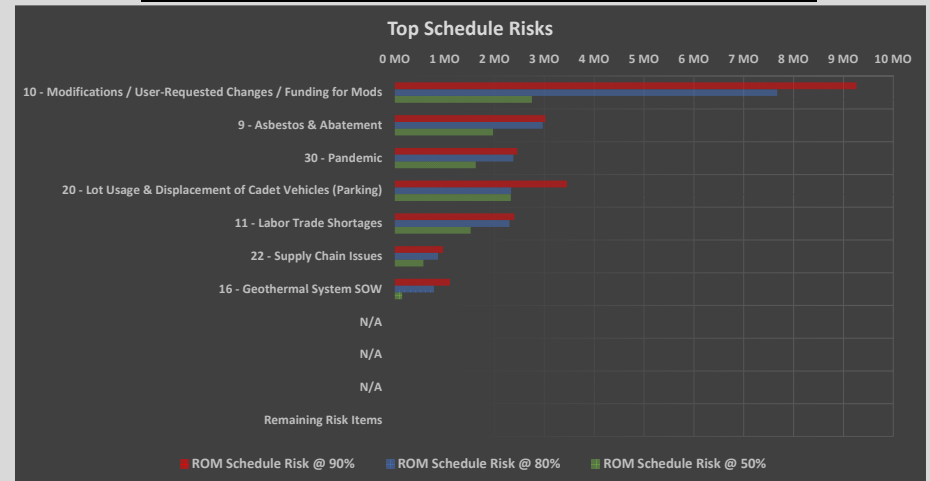
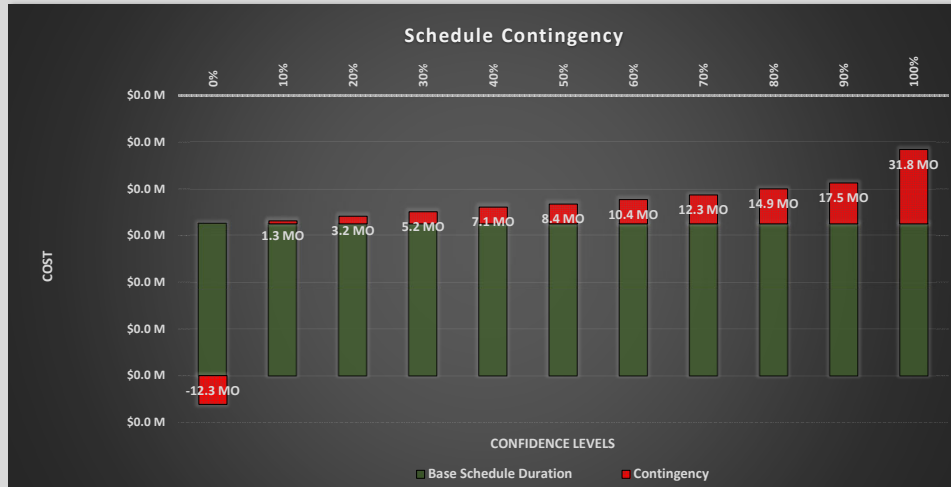
TOP COST RISKS

Risk/Opportunity Event	Risk Event Description	PDT Discussions on Impact and Likelihood	Responsibility/ POC	Risk Level		Suggested Risk Reduction Measures (Avoid, Escalate, Exploit, Transfer/Share, Mitigate/Enhance, or Accept)
				Cost	Schedule	
1	Funding Availability for Award of Contract	~ DD1391 is currently based on 65% cost estimate, but hope to update it. ~ No funding for mods. Approval of current DD1391 may not happen before anticipated October 2022 award date. If updated, would definitely not meet October 2022 deadline WC: Adjustments to base estimate & schedule may delay project by one fiscal year. The schedule contingency is not modeled since this CSRA is focused on construction risk and not design risk but this risk does impact construction costs if we are delayed a year (so the cost impact is modeled).	Project Management	Medium	High	Need PDT input on risk reduction measures.
22	Supply Chain Issues	Longer lead times could effect cost or schedule Many long lead items already identified in schedule. Shortening the lead time may cost more due to having to pay premiums. Market may be better at the time of award, so track as risk rather than adding cost in base estimate at this time. WC: Assume 12-month lead time with 10 - 15% premium markup on materials OR 18-month lead time with no premium.	Cost Engineering	Medium	High	Need PDT input on risk reduction measures.
13	Prime vs. Subcontracted Work	~ If Prime is outside the area, sometimes they have trouble getting subcontractors to work with them. ~ The amount of work performed by the prime vs. subs can impact costs. ~ Variation in assumed rates for contractor markups. ~ Typically have good competition with experienced contractors as well as contractor's proposals outside the area. ~ Sources sought to see what the interest is has already been done (should know by FEB 22, 2022). ~ The base estimate assumes a prime contractor who subs out most of the work and primarily provides oversight and manages the work. BC: Prime may self-perform some of the work (i.e. utilities, concrete, general laborers, demolition) but specialty trades will likely be sub contractors. Lower contractor markup rates than reflected in current estimate WC: Higher contractor markup rates than reflected in current estimate.	Cost Engineering	High	Low	Need PDT input on risk reduction measures.
16	Geothermal System SOW	~ Quantity & depth. ~ Duration for drilling of holes (depends on number of rigs) The base estimate and schedule assumes two rigs with 6 months to install. PDT is confident in scope and subcontractor quote received. Current scope is 605' depth and 181 holes. The geothermal SOW is critical path work. WC: Assume 1 rig (due to depth of holes, number of large rigs could be limited) which could add 4-months to the critical path schedule.	Geotechnical Design	Medium	High	Need PDT input on risk reduction measures.

Schedule Risk Dashboard

Project: Project Name
 Location: Walla Walla, WA

Contingency on Base Schedule	50% Confidence Project Schedule	
Base Schedule Start Date	October 1, 2021	
Base Schedule Finish Date	March 1, 2027	
Base Schedule Duration	65.0 Months	13%
Schedule Contingency Duration	8.4 Months	
Base Schedule w/ Contingency (50% Confidence)	73.4 Months	
Base Finish Date w/ Contingency (50% Confidence)	November 15, 2027	



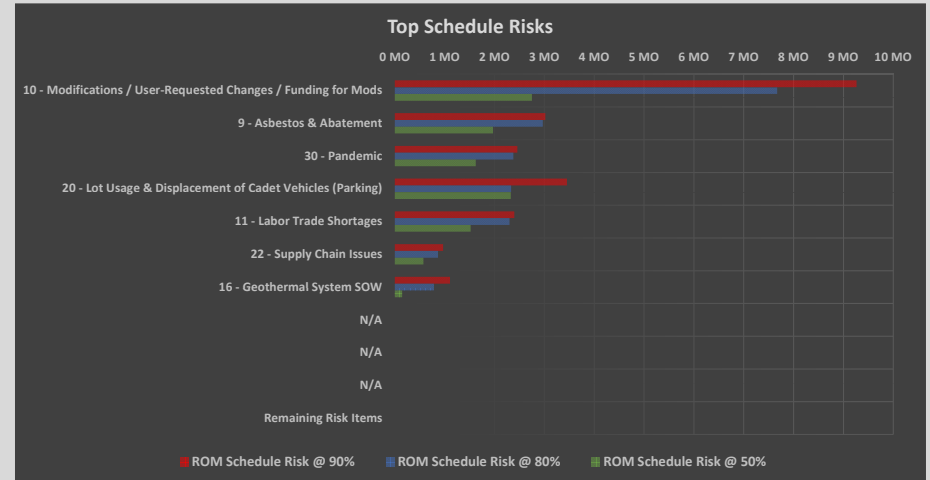
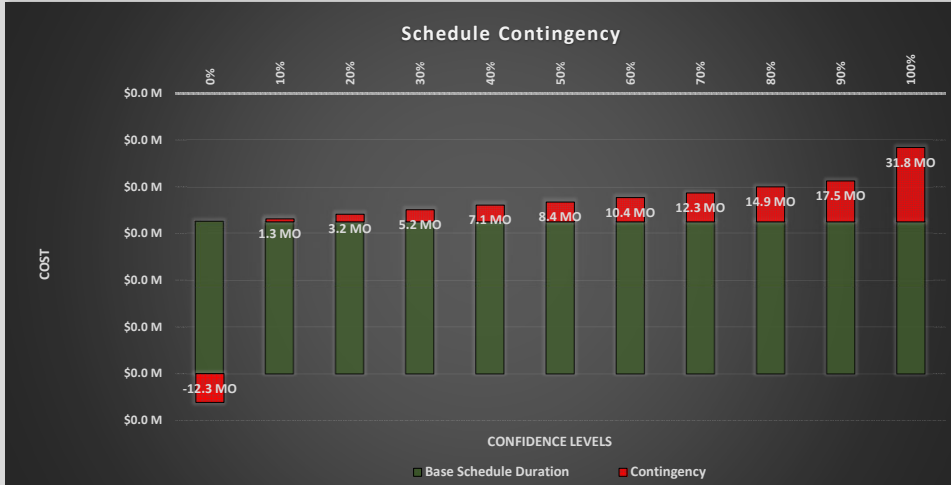
TOP SCHEDULE RISKS

Risk/Opportunity Event	Risk Event Description	PDT Discussions on Impact and Likelihood	Responsibility/ POC	Risk Level		Suggested Risk Reduction Measures (Avoid, Escalate, Exploit, Transfer/Share, Mitigate/Enhance, or Accept)
				Cost	Schedule	
10	Modifications / User- Requested Changes / Funding for Mods	~Modifications exist on every project. ~ Availability of funding / time it takes to receive funding for change orders could also impact cost/schedule as well.	Project Management	High	High	Need PDT input on risk reduction measures.
9	Asbestos & Abatement	Full abatement is currently not included in the estimate or schedule. Doing demolition and investigation early on in construction can help identify what work could be anticipated. Changes in the current assumptions could affect cost/schedule.	Environmental Compliance	High	High	Need PDT input on risk reduction measures.
30	Pandemic	Pandemic outbreaks could cause delays to construction or availability of materials.	Project Management	Low	High	Need PDT input on risk reduction measures.
20	Lot Usage & Displacement of Cadet Vehicles (Parking)	Lower Sijan lot usage. Lay down yards, displacement of cadets vehicles. Furniture moves Dorm and storage issues. Continually operation of required assets, trailers/offices. Possible lay down areas. Funding issues for non reno assets.	Customer	Medium	Medium	Need PDT input on risk reduction measures.

Schedule Risk Dashboard

Project: Project Name
 Location: Walla Walla, WA

Contingency on Base Schedule	50% Confidence Project Schedule	
Base Schedule Start Date	October 1, 2021	
Base Schedule Finish Date	March 1, 2027	
Base Schedule Duration	65.0 Months	13%
Schedule Contingency Duration	8.4 Months	
Base Schedule w/ Contingency (50% Confidence)	73.4 Months	
Base Finish Date w/ Contingency (50% Confidence)	November 15, 2027	



TOP SCHEDULE RISKS

Risk/Opportunity Event	Risk Event Description	PDT Discussions on Impact and Likelihood	Responsibility/ POC	Risk Level		Suggested Risk Reduction Measures (Avoid, Escalate, Exploit, Transfer/Share, Mitigate/Enhance, or Accept)
				Cost	Schedule	
11	Labor Trade Shortages	Primarily related to roofers, concrete, and electricians. ~ Depends on how much work is taking place in Denver ~ Could be additional labor costs for per diem, etc. ~ Could impact productivity assumptions as well if not enough trade is available to achieve the higher production rates.	Cost Engineering	High	High	Need PDT input on risk reduction measures.
22	Supply Chain Issues	Longer lead times could effect cost or schedule	Cost Engineering	Medium	High	Need PDT input on risk reduction measures.
16	Geothermal System SOW	~ Quantity & depth. ~ Duration for drilling of holes (depends on number of rigs)	Geotechnical Design	Medium	High	Need PDT input on risk reduction measures.
N/A						
N/A						
N/A						

Appendix C-2

Contingency Summary

Project Contingency

Project Name

October 2022

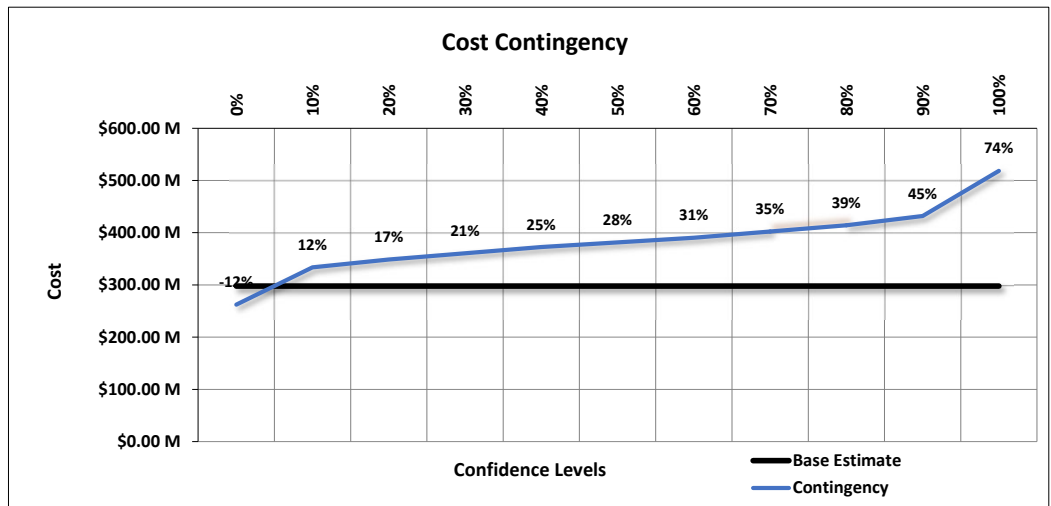
Contingency on Base Estimate	50% Confidence Project Cost
Base Estimate	\$297,942,392
Estimate Contingency	\$83,423,870 28%
Base Estimate w/ Contingency (50% Confidence)	\$381,366,262

Contingency on Base Schedule	50% Confidence Project Schedule
Base Schedule Start Date	October 1, 2021
Base Schedule Finish Date	March 1, 2027
Base Schedule Duration	65.0 Months
Schedule Contingency Duration	8.4 Months 13%
Base Schedule w/ Contingency (50% Confidence)	73.4 Months
Base Finish Date w/ Contingency (50% Confidence)	November 15, 2027

- PROJECT COST CONTINGENCY DEVELOPMENT -

Cost Contingency Analysis

Base Estimate		\$297,942,392	
Confidence Level	Contingency Value	Contingency	Cost with Contingency
0%	-\$35,753,087	-12%	\$262,189,305
10%	\$35,753,087	12%	\$333,695,479
20%	\$50,650,207	17%	\$348,592,599
30%	\$62,567,902	21%	\$360,510,295
40%	\$74,485,598	25%	\$372,427,990
50%	\$83,423,870	28%	\$381,366,262
60%	\$92,362,142	31%	\$390,304,534
70%	\$104,279,837	35%	\$402,222,230
80%	\$116,197,533	39%	\$414,139,925
90%	\$134,074,077	45%	\$432,016,469
100%	\$220,477,370	74%	\$518,419,763



Project Contingency

Project Name

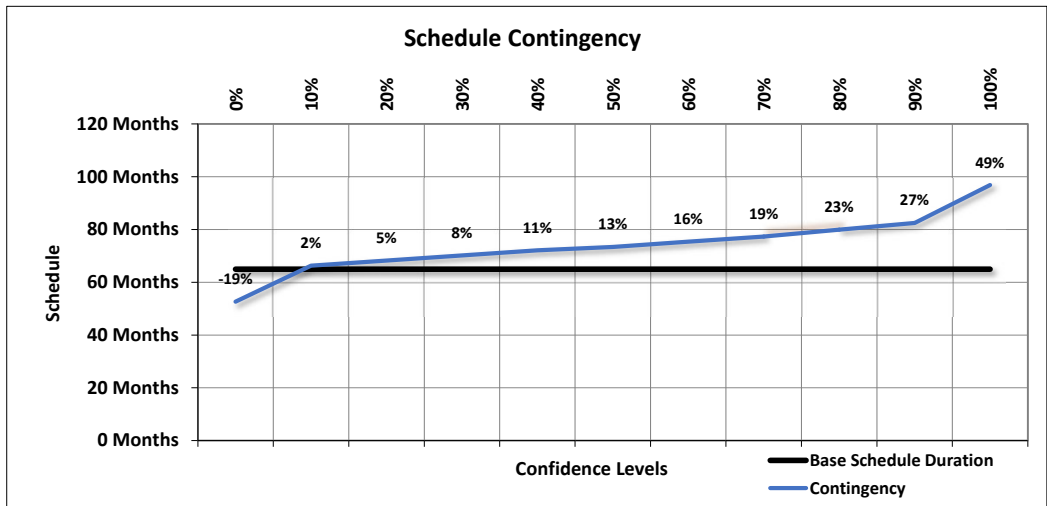
October 2022

Contingency on Base Estimate	50% Confidence Project Cost
Base Estimate	\$297,942,392
Estimate Contingency	\$83,423,870 28%
Base Estimate w/ Contingency (50% Confidence)	\$381,366,262

Contingency on Base Schedule	50% Confidence Project Schedule
Base Schedule Start Date	October 1, 2021
Base Schedule Finish Date	March 1, 2027
Base Schedule Duration	65.0 Months
Schedule Contingency Duration	8.4 Months 13%
Base Schedule w/ Contingency (50% Confidence)	73.4 Months
Base Finish Date w/ Contingency (50% Confidence)	November 15, 2027

- PROJECT SCHEDULE CONTINGENCY (DURATION) DEVELOPMENT -

Schedule Contingency Analysis			
Base Schedule Duration	65.0 Months		
Confidence Level	Contingency Value	Contingency	Duration with Contingency
0%	-12.3 Months	-19%	52.6 Months
10%	1.3 Months	2%	66.3 Months
20%	3.2 Months	5%	68.2 Months
30%	5.2 Months	8%	70.2 Months
40%	7.1 Months	11%	72.1 Months
50%	8.4 Months	13%	73.4 Months
60%	10.4 Months	16%	75.4 Months
70%	12.3 Months	19%	77.3 Months
80%	14.9 Months	23%	79.9 Months
90%	17.5 Months	27%	82.5 Months
100%	31.8 Months	49%	96.8 Months



Appendix C-3

Sensitivity Charts

Sensitivity Charts

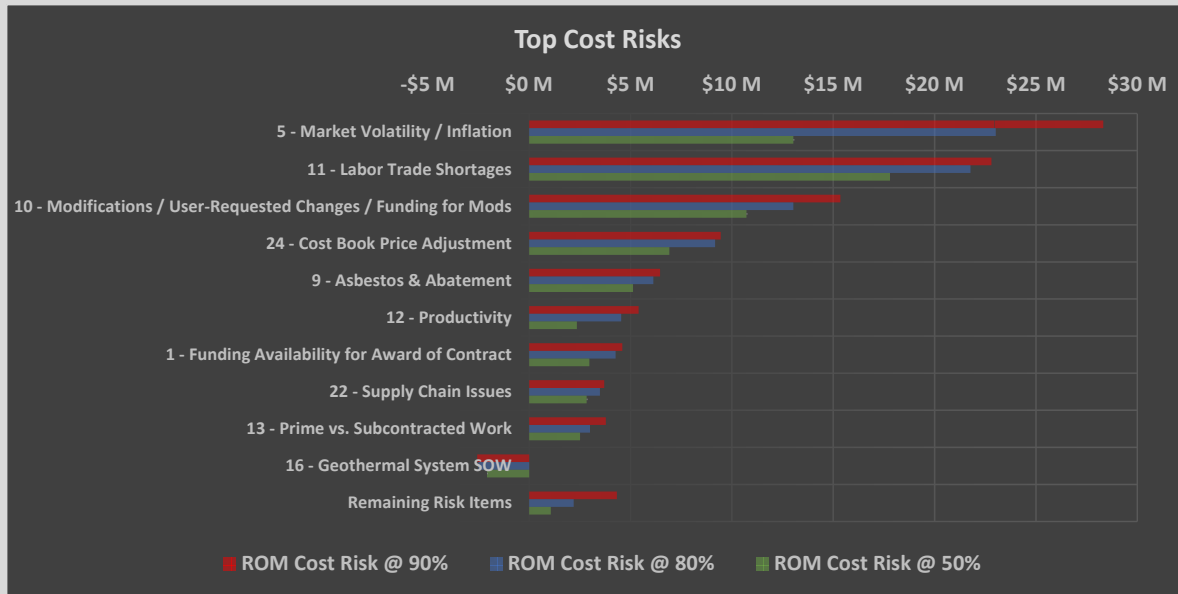
Project Name

October 2022

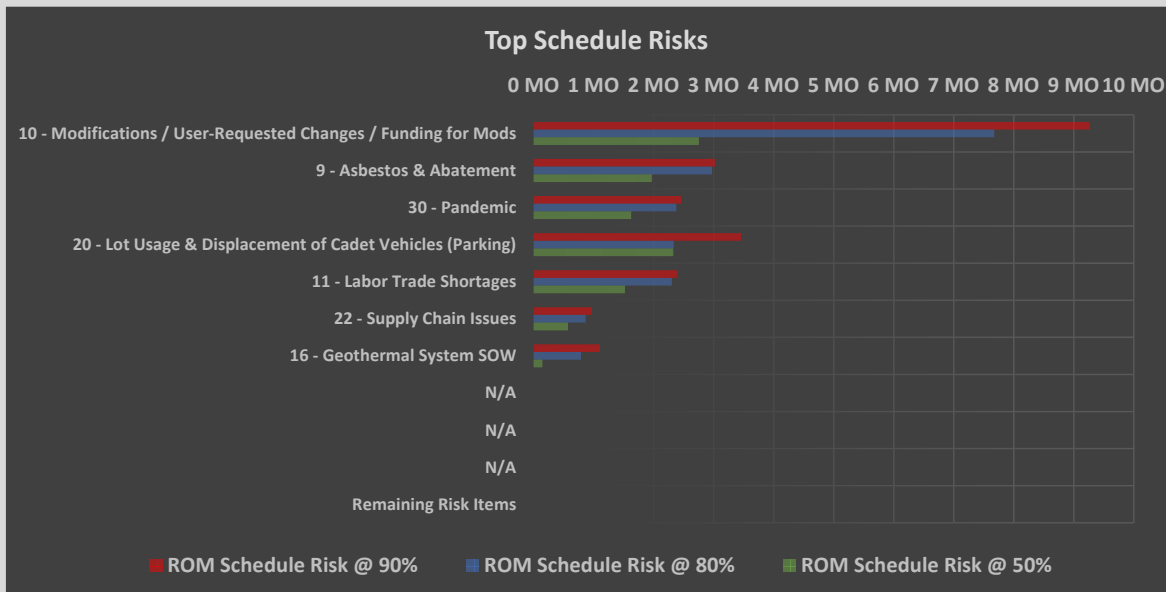
Contingency on Base Estimate		50% Confidence Project Cost	
	Base Estimate	\$297,942,392	
	Estimate Contingency	\$83,423,870	28%
	Base Estimate w/ Contingency (50% Confidence)	\$381,366,262	

Contingency on Base Schedule		50% Confidence Project Schedule	
	Base Schedule Start Date	October 1, 2021	
	Base Schedule Finish Date	March 1, 2027	
	Base Schedule Duration	65.0 Months	
	Schedule Contingency Duration	8.4 Months	13%
	Base Schedule w/ Contingency (50% Confidence)	73.4 Months	
	Base Finish Date w/ Contingency (50% Confidence)	November 15, 2027	

- Top Cost Risk Drivers by Confidence Levels -



- Top Schedule Risk Drivers by Confidence Levels -



Sensitivity Charts

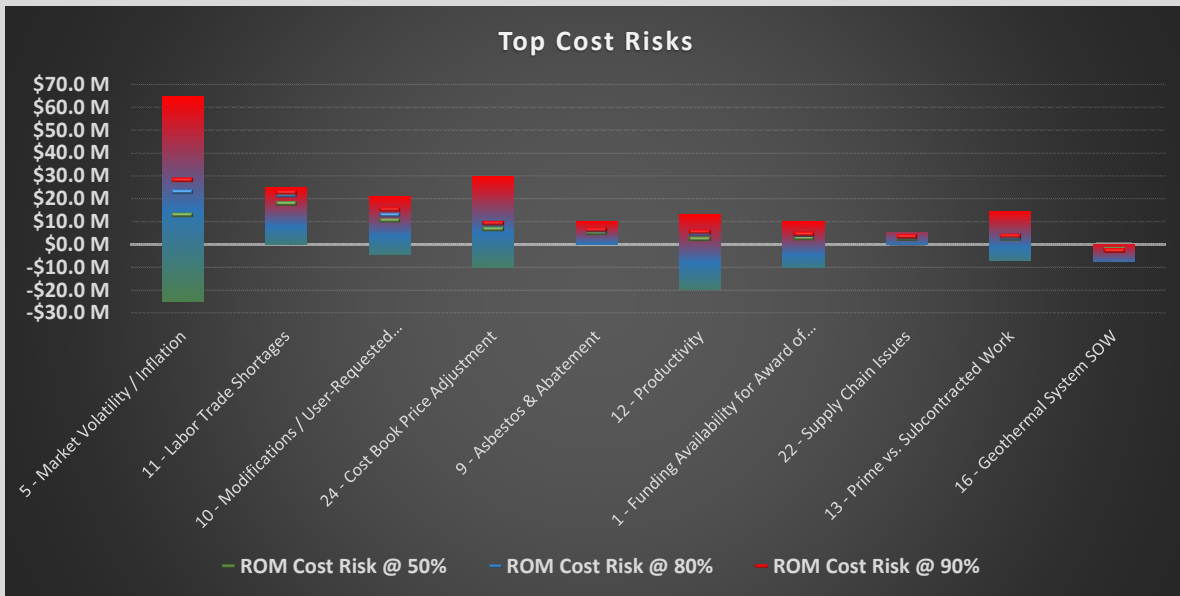
Project Name

October 2022

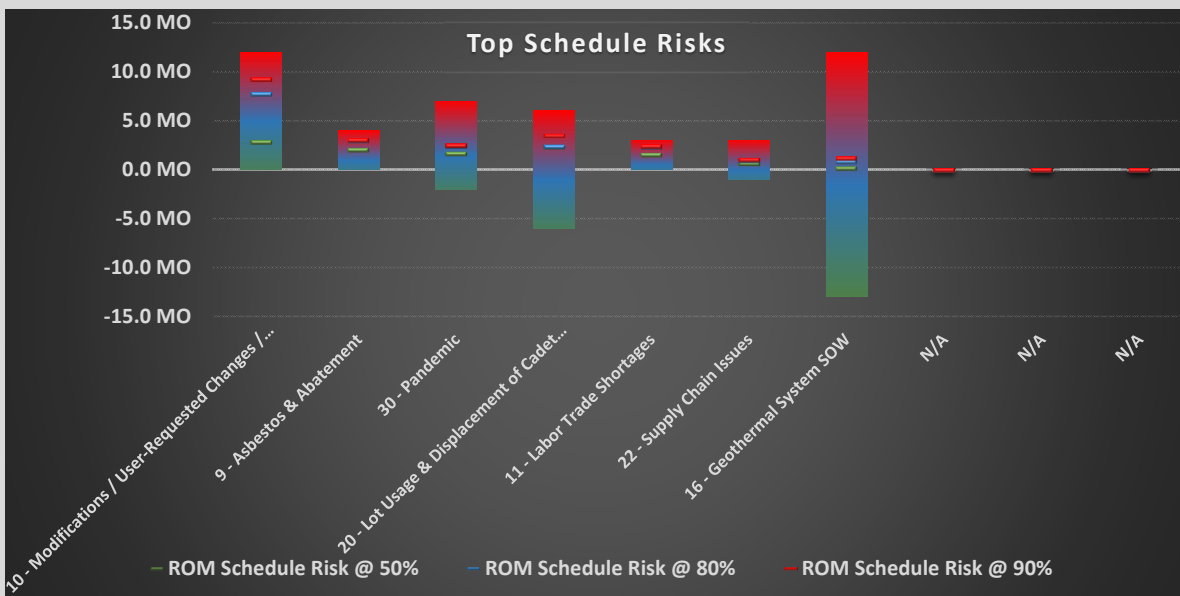
Contingency on Base Estimate		50% Confidence Project Cost	
	Base Estimate	\$297,942,392	
	Estimate Contingency	\$83,423,870	28%
	Base Estimate w/ Contingency (50% Confidence)	\$381,366,262	

Contingency on Base Schedule		50% Confidence Project Schedule	
	Base Schedule Start Date	October 1, 2021	
	Base Schedule Finish Date	March 1, 2027	
	Base Schedule Duration	65.0 Months	
	Schedule Contingency Duration	8.4 Months	13%
	Base Schedule w/ Contingency (50% Confidence)	73.4 Months	
	Base Finish Date w/ Contingency (50% Confidence)	November 15, 2027	

- Top Cost Risk Drivers & Ranges -



- Top Schedule Risk Drivers & Ranges -



Appendix C-4

Risk Register

Risk Register

Information	Probability of Occurrence	Certain > 90%	Very Likely 70-90%	Likely 30-70%	Possible 5-30%	Unlikely < 5%	Unrated N/A	
	Cost & Schedule Impacts	Negligible < \$1,500,000 < 1.00 MO		Marginal \$1,500,000 to \$3,000,000 1.00 MO to 1.50 MO		Moderate \$3,000,000 to \$7,500,000 1.50 MO to 3.50 MO		Significant \$7,500,000 to \$15,000,000 3.50 MO to 6.50 MO

Risk Rating		Negligible	Marginal	Moderate	Significant	Critical
	Certain	RELOOK AT BASIS OF ESTIMATE				
	Very Likely	Low	Medium	High	High	High
	Likely	Low	Medium	Medium	High	High
	Possible	Low	Low	Medium	Medium	High
	Unlikely	Low	Low	Low	Medium	Medium

Project Name - Current Working Estimate October 2022															
REF	Risk Type	Risk/Opportunity Event	Risk Event Description	PDT Discussions on Impact and Likelihood	Likelihood	Project Cost		Project Schedule		Other Information			Affected Project Component	Additional Documentation (Avoid, Escalate, Exploit, Transfer/Share, Mitigate/Enhance, or Accept)	
						Impact (C)	Risk Level (C)	Impact (S)	Risk Level (S)	Cost Variance Distribution	Schedule Variance Distribution	Correlation to Other(s)			Responsibility/ POC
1	4 - External Risks (EX)	Funding Availability for Award of Contract	~ DD1391 is currently based on 65% cost estimate, but hope to update it. ~ No funding for mods.	Approval of current DD1391 may not happen before anticipated October 2022 award date. If updated, would definitely not meet October 2022 deadline WC: Adjustments to base estimate & schedule may delay project by one fiscal year. The schedule contingency is not modeled since this CSRA is focused on construction risk and not design risk but this risk does impact construction costs if we are delayed a year (so the cost impact is modeled).	Very Likely	Marginal	Medium	Critical	High	Single Event (2 Step)	Single Event (2 Step)	3, 4	Project Management	Project Cost & Schedule	Need PDT input on risk reduction measures.
2	4 - External Risks (EX)	Receipt of Funding	Delay in funding due to continuing resolution.	Current schedule assumes we receive funding mid-October with NTP of Nov 8. BC: 3-month delay for CR WC: 6-month delay for CR; critical path delay, cadet movement would push to May/June 2024 (potential 7 month delay); unable to use current FY funds for mods. This risk is captured in REF 10.	Likely	Moderate	Medium	Critical	High	N/A -Not Modeled	N/A -Not Modeled	10	Project Management	N/A -Not Modeled	Did not model schedule risk since it is a PED activity (non-construction).
3	2 - Scope and Objectives (SC)	Design	~Incorporate furniture & equipment moving into design (new scope is not well defined) ~Whole building vs. spot asbestos abatement (potential change to scope)	BC: 4 month design delay WC: 6 month design delay This risk is captured in REF 1 since it would mitigate this risk item if it were to occur.	Very Likely	Marginal	Medium	Critical	High	N/A -Not Modeled	N/A -Not Modeled	1, 4	Technical Lead	Project Cost & Schedule	Did not model schedule risk since it is a PED activity (non-construction).
4	5 - Contract Acquisition Risks (CA)	Procurement & Award / Contract Acquisition Method	The timing of award and submittals could impact the construction duration if delays are encountered. ~BVTO ~Bid Protest?	Currently have 4 months from RTA to award. Additional time to evaluate proposals (multiple rounds)? Proposals/bids come in outside of awardable range? 6 months for additional design + 4 months for procurement/award = 10 months of potential additional time. Risk item 1 (Funding Availability) has 12 months of total time; therefore 2 months of float for procurement/award process. The base schedule assumes an award on 1 Oct for each contract: ~ 15 days for preliminary schedule is typical ~ 45 days for final construction schedule is typical ~ 30-60 days for preconstruction submittals (safety plan, env plan, QC plan) This risk is captured in REF 1 since it would mitigate this risk item if it were to occur.	Possible	Marginal	Low	Significant	Medium	N/A -Not Modeled	N/A -Not Modeled	1, 3	Contracting	Project Schedule	Did not model schedule risk since it is a PED activity (non-construction).
5	14 - Estimate and Schedule Risks (ES)	Market Volatility / Inflation	~Choosing escalation percentages to get to midpoint of construction. ~ A lot of volatility in the market right now.	Current assumption has inflation at approximately 3% per year (on the low side). Latest ENR Building Cost Index 3-year trend is about 7.2% for the Denver, CO area.	Very Likely	Critical	High	Negligible	Low	Triangular	N/A -Not Modeled		Cost Engineering	Project Cost	Need PDT input on risk reduction measures.
6	1 - Project & Program Management (PM)	Phasing of Contracts	~Answering the questions posed by leadership (one contract; 12-month phases) ~Commissioning and warranty complications (By the time we finish Phase 5 work, Phase 1 work may be 7 years old - what is impact from each Phase's new work on Phase 1 systems? Phase 1 systems might be out of warranty by the end of Phase 5? Add multiple commissioning and/or extended warranties over multiple phases?)	Option 1: 5 phases (current plan) Option 2: single contract (won't work under funding constraints) Option 3: one year at a time for each phase (is this feasible?) How to model these options? Need pros & cons sound bites. Ideas for other possible alternatives. Impacts to cost and schedule for each of these options/alternatives. There are impacts to cost and schedule for non-construction activities. This risk item is to document that various options are still being formulated to determine the implementation strategy.	Possible	Negligible	Low	Negligible	Low	N/A -Not Modeled	N/A -Not Modeled		Customer	N/A -Not Modeled	Low risk item.
7	12 - Civil/Site Design (CV)	Unforeseen Site Conditions	~Temporary use of existing systems that are tied into new systems (new materials/equipment may negatively impact existing systems) ~Behavior of existing systems as loads are shifted to new systems ~Condition of existing underground utilities - tapping into old systems may cause damage - mod to repair it (i.e. water mains) ~Old systems damaging new systems where both are in operation	Potential subfloor issues, asbestos, and geothermal, user requested changes covered under other risk elements Ensure most recent as-builts are included in drawing package prior to solicitation Individual events may be in negligible range	Possible	Marginal	Low	Negligible	Low	N/A -Not Modeled	N/A -Not Modeled		Civil/Site Design	N/A -Not Modeled	Low risk item.
8	3 - Ability to Execute (AB)	Moving of Furniture	~ Contractor or USAFA moving furniture to another part of the building & storing it. ~ Could also be a risk item depending on timing. ~ Temporary space for the chaplain offices. ~ Move two squadrons to Vandenberg (furniture comes from Sijan storage), move two squadrons within Sijan ~ Furniture in Phase 1 dorm rooms moves to off-site storage ~ Movement of furniture back to Sijan during Phase 5 ~Coordination of funding from various tenant agencies	Additional information from Pat on moving of dorm rooms necessitates an update to base cost and schedule . Timeline is: receipt of funding -- NTP -- mobilizing moving contractor -- executing moves. Identified risks (1) delay in receipt of funding; (2) not finishing moves prior to end of winter break; (3) planning of details of moves by all entities (CW is working on it now --> CE, Chaplain's office, FSS)	Very Likely	Negligible	Low	Negligible	Low	N/A -Not Modeled	N/A -Not Modeled		Project Management	N/A -Not Modeled	Low risk item.
9	21 - Environmental & Cultural/Historical Resources (EC)	Asbestos & Abatement	Full abatement is currently not included in the estimate or schedule. Doing demolition and investigation early on in construction can help identify what work could be anticipated. Changes in the current assumptions could affect cost/schedule.	~Current scope: isolated areas (flooring, finishes) need abatement, assuming all mechanical rooms are to be fully abated, spot abatement of fireproofing on columns (where it is disturbed). Vertical pipe insulation could be ACM? ~USAFA may want all vertical columns fireproofing to be fully abated. All tiles surrounding columns are to be pulled up anyway. Add new fireproofing. ~A contractor might identify dust build up which could be contaminated (mech rooms, crawl spaces below vertical chases) - would it be categorized as a spill? If categorized as major spill, it would require Level 3 containment. If fireproofing is abated, this would not be as much of a risk. Full abatement of fireproofing includes cleanup of crawl space. ~ Per RFI, full abatement of columns in Phase 1 is approx. \$894K, vs \$770K for partial abatement and encapsulation for Phase 1 (98 columns that intersect crawl space; containment, abatement, bagging, negative air equipment - also need abatement plan preparation and approval). There is almost 2.5 months of anticipated float, but full abatement could extend the critical path schedule by 5 months.	Very Likely	Moderate	High	Critical	High	Triangular	Triangular		Environmental Compliance	Project Cost & Schedule	Need PDT input on risk reduction measures.
10	13 - Construction (CO)	Modifications / User-Requested Changes / Funding for Mods	~Modifications exist on every project. ~ Availability of funding / time it takes to receive funding for change orders could also impact cost/schedule as well.	Chasing prior year money for change orders (OARS); it takes 2 to 6 months (or as long as 12 months) to receive the funds after requesting the funds. In addition to cost of work in the change order, schedule delay adds additional overhead cost; impact to cost depends on dollar value of change order and time it takes to get the funding.	Very Likely	Significant	High	Critical	High	Uniform	Uniform	2	Project Management	Project Cost & Schedule	Need PDT input on risk reduction measures.

Risk Register

Information	Probability of Occurrence	Certain	Very Likely	Likely	Possible	Unlikely	Unrated		
		> 90%	70-90%	30-70%	5-30%	< 5%	N/A		
Cost & Schedule Impacts		Negligible		Marginal		Moderate		Significant	Critical
		< \$1,500,000		\$1,500,000 to \$3,000,000		\$3,000,000 to \$7,500,000		\$7,500,000 to \$15,000,000	> \$15,000,000
		< 1.00 MO		1.00 MO to 1.50 MO		1.50 MO to 3.50 MO		3.50 MO to 6.50 MO	> 6.50 MO
Risk Rating			Negligible	Marginal	Moderate	Significant	Critical		
	Certain	RELOOK AT BASIS OF ESTIMATE							
	Very Likely	Low	Medium	High	High	High	High	High	High
	Likely	Low	Medium	Medium	High	High	High	High	High
	Possible	Low	Low	Medium	Medium	High	High	High	High
	Unlikely	Low	Low	Low	Medium	Medium	High	High	High

Project Name - Current Working Estimate October 2022															
REF	Risk Type	Risk/Opportunity Event	Risk Event Description	PDT Discussions on Impact and Likelihood	Likelihood	Project Cost		Project Schedule		Other Information			Affected Project Component	Suggested Risk Reduction Measures (Avoid, Escalate, Exploit, Transfer/Share, Mitigate/Enhance, or Accept)	
						Impact (C)	Risk Level (C)	Impact (S)	Risk Level (S)	Cost Variance Distribution	Schedule Variance Distribution	Correlation to Other(s)			Responsibility/ POC
11	4 - External Risks (EX)	Labor Trade Shortages	Primarily related to roofers, concrete, and electricians. ~ Depends on how much work is taking place in Denver ~ Could be additional labor costs for per diem, etc. ~ Could impact productivity assumptions as well if not enough trade is available to achieve the higher production rates.	The base estimate assumes per diem for roofer, concrete, and electrician workers. Productivity risk is captured in the risk item below. There is a \$320M North Gate project - partnership between USAFA and city, should be done by 2024; Field House Phase 3 \$50M. Could this problem expand to other trades? The prime contractor typically brings in out-of-state workers. WC: Apply per diem for other trades in base estimate; unable to bring in workers - assume 20% schedule impact.	Very Likely	Critical	High	Critical	High	Triangular	Triangular		Cost Engineering	Project Cost & Schedule	Need PDT input on risk reduction measures.
12	14 - Estimate and Schedule Risks (ES)	Productivity	~ Could be impacted by availability of trade workers as mentioned in risk item 11. ~ Base estimate assumes 70% productivity factor for renovation work.	After demo is complete, we basically have an empty shell - is 70% productivity too low, or should we narrow that productivity to fewer project items/folders? Because building in occupied in general, there are certain restrictions which would impact productivity. The 70% is typical for renovation work. Also accounting for an hour or two due to get to/from the building from parking/storage yard could impact how many actual production work hours vs billed work hours are performed in a day.	Very Likely	Significant	High	Critical	High	Triangular	Triangular		Cost Engineering	Project Cost & Schedule	Need PDT input on risk reduction measures.
13	14 - Estimate and Schedule Risks (ES)	Prime vs. Subcontracted Work	~ If Prime is outside the area, sometimes they have trouble getting subcontractors to work with them. ~ The amount of work performed by the prime vs. subs can impact costs. ~ Variation in assumed rates for contractor markups.	~ Typically have good competition with experienced contractors as well as contractor's proposals outside the area. ~ Sources sought to see what the interest is has already been done (should know by FEB 22, 2022). ~ The base estimate assumes a prime contractor who subs out most of the work and primarily provides oversight and manages the work. BC: Prime may self-perform some of the work (i.e. utilities, concrete, general laborers, demolition) but specialty trades will likely be sub contractors. Lower contractor markup rates than reflected in current estimate WC: Higher contractor markup rates than reflected in current estimate.	Very Likely	Moderate	High	Negligible	Low	Triangular	N/A -Not Modeled		Cost Engineering	Project Cost	Need PDT input on risk reduction measures.
14	3 - Ability to Execute (AB)	Transition Between Contracts	~ Risk related to transitional areas and potential of re-work ~ Competing CWLs for laydown areas, staging areas, etc.	Since this CSRA was focused on Phase 1, this risk is not evaluated on how it impacts the remaining contracts or phases when transitioning between contracts, laydown areas, storage areas, etc.	Very Likely	Negligible	Low	Negligible	Low	N/A -Not Modeled	N/A -Not Modeled		Project Management	N/A -Not Modeled	Low risk item.
15	14 - Estimate and Schedule Risks (ES)	Work Calendars / Non-Work Days	Working around student life and/or activities could impact costs and the construction schedule. ~No work allowed during six sanctioned days/events and other designated events ~Quiet hours 0700 - 1800 (but prefer 0800 - 1730) ~ Standard mission delay days - 5 days for unscheduled/unexpected work stoppage (for duration of contract) (by phase) ~ 1-week for graduation (end of May - 1st week of June) ~ Corona conference (one week in NOV) ~ Move in or move out days ~ Should be able to work around football days (no deliveries allowed) ~ In-processing day ~ Parents weekend (no deliveries) holidays (2 weeks per year); contractors might work on some Federal holidays ~Standard weather delays (wind & lightning for exterior work)	~ The base schedule assumes an MTWRF 8-5 work schedule. Do we actually pay for 9-hours per day even though production work is 8-hours? ~ Base schedule assumes approx. 2 weeks of non-work days per year, as detailed in risk event description (no weather delays). ~ Mitigation could be allowing contractor to work during some of those days/times. ~ Mods for weather delays are not commonly seen or excessive. BC: 9-work hours per day instead of 8 work hours per day (pay OT but shorter schedule & less FOOH) WC: 2 additional weeks of non-work days per year	Very Likely	Negligible	Low	Significant	High	N/A -Not Modeled			Cost Engineering	Project Schedule	Need PDT input on risk reduction measures.
16	14 - Estimate and Schedule Risks (ES)	Geothermal System SOW	~ Quantity & depth. ~ Duration for drilling of holes (depends on number of rigs)	The base estimate and schedule assumes two rigs with 6 months to install. PDT is confident in scope and subcontractor quote received. Current scope is 605' depth and 181 holes. The geothermal SOW is critical path work. WC: Assume 1 rig (due to depth of holes, number of large rigs could be limited) which could add 4-months to the critical path schedule.	Likely	Marginal	Medium	Critical	High	Triangular	Triangular		Geotechnical Design	Project Cost & Schedule	Need PDT input on risk reduction measures.
17	2 - Scope and Objectives (SC)	Abatement of Existing Sprinkler System	Not part of 65% estimate; is included in base schedule	Abatement: careful excavation, glove bag operation, no containment needed; ROM quantity is 5,000 LF of pipe to be removed @ \$15/LF = \$75K	Likely	Negligible	Low	Negligible	Low	N/A -Not Modeled	N/A -Not Modeled		Environmental Compliance	N/A -Not Modeled	Low risk item.
18	11 - Architectural and Interior (AI)	Architectural / Exterior Closure / Interior Finishes	~Design refinement of scope/quantities from 65% to 95% ~Unforeseen interior subfloor damage ~Potential high moisture content in bathroom areas ~Potential concrete damage beneath exterior terrazzo system ~Curtain wall anchor points - replace all?	Exterior look must be maintained. Connection between new system and old system between phases is important. Scope from 65% to 95% is stable. Subflooring: moved a storage area, did concrete core testing to determine load capacity - no issues. Demo of flooring sometimes damages subfloor and some repair/patching of concrete may be required. Specifications will require level subfloor prior to installing new flooring. Bathroom areas will likely have high moisture content - is moisture content of concrete addressed in specification? Terrazzo waterproofing system - have leaks caused damage to concrete?	Possible	Marginal	Low	Negligible	Low	N/A -Not Modeled	N/A -Not Modeled		Architectural	N/A -Not Modeled	Low risk item.
19	15 - Electrical (EE)	Electrical	Design refinement of scope/quantities from 65% to 95%	no concern on conduit & cable material availability; some concern regarding fire alarm devices (circuit boards have a long backlog); temporary facilities not part of current estimate. Revisit after 95% submittal on February 22, 2022.	Possible	Negligible	Low	Negligible	Low	N/A -Not Modeled	N/A -Not Modeled		Electrical Design	N/A -Not Modeled	Low risk item.
20	6 - Planning-Site (PS)	Lot Usage & Displacement of Cadet Vehicles (Parking)	Lower Sijan lot usage, Lay down yards, displacement of cadets vehicles. Furniture moves Dorm and storage issues. Continually operation of required assets, trailers/offices. Possible lay down areas. Funding issues for non reno assets.	Assumption: 1/3 to 1/2 of Cadet parking lot and all of parking directly south of Sijan Hall along road for contractor laydown and storage areas. Risk that we don't get as much area and contractor areas would be moved off-site. Productivity impact and cost of effort for contractor to bus workforce and/or accessing materials from a remote location. Might need to add overtime to schedule due to lost productivity. Estimated 120 to 130 contractor employees. Movement of materials/equipment from remote laydown area. Truck traffic due to daily material deliveries - impact if delays at gate. Site access coordination between this project and Chapel project (grassy area north of Sijan Hall). USAFA check on cost impact ROM for Chapel project. Currently not modeled. Per discussions with contractors at industry day, some were anticipating a 5-8% impact to the total contract if this risk did occur.	Unlikely	Significant	Medium	Critical	Medium	Single Event (2 Step)	Single Event (2 Step)		Customer	Project Cost & Schedule	Need PDT input on risk reduction measures.
21	29 - Equipment List (EQ)	Modernization of Conference Rooms	New group look: Centralized in the dorm and look. New Conference room look.	conference rooms already part of design; does current base estimate include cost for modern conference rooms? Advancing the design in 95%	Possible	Negligible	Low	Negligible	Low	N/A -Not Modeled	N/A -Not Modeled		Customer	N/A -Not Modeled	Low risk item.

Risk Register

Information	Probability of Occurrence					
	Certain	Very Likely	Likely	Possible	Unlikely	Unrated
	> 90%	70-90%	30-70%	5-30%	< 5%	N/A
Cost & Schedule Impacts	Negligible		Marginal		Moderate	
	< \$1,500,000		\$1,500,000 to \$3,000,000		\$3,000,000 to \$7,500,000	
	< 1.00 MO		1.00 MO to 1.50 MO		1.50 MO to 3.50 MO	
Risk Rating	RELOOK AT BASIS OF ESTIMATE					
	Certain	Negligible	Marginal	Moderate	Significant	Critical
	Very Likely	Low	Medium	High	High	High
	Likely	Low	Medium	Medium	High	High
	Possible	Low	Low	Medium	Medium	High
	Unlikely	Low	Low	Low	Medium	Medium

Project Name - Current Working Estimate October 2022															
REF	Risk Type	Risk/Opportunity Event	Risk Event Description	PDT Discussions on Impact and Likelihood	Likelihood	Project Cost		Project Schedule		Other Information			Affected Project Component	Additional Documentation (Avoid, Escalate, Exploit, Transfer/Share, Mitigate/Enhance, or Accept)	
						Impact (C)	Risk Level (C)	Impact (S)	Risk Level (S)	Cost Variance Distribution	Schedule Variance Distribution	Correlation to Other(s)			Responsibility/ POC
22	4 - External Risks (EX)	Supply Chain Issues	Longer lead times could effect cost or schedule	Many long lead items already identified in schedule. Shortening the lead time may cost more due to having to pay premiums. Market may be better at the time of award, so track as risk rather than adding cost in base estimate at this time. WC: Assume 12-month lead time with 10 - 15% premium markup on materials OR 18-month lead time with no premium.	Very Likely	Marginal	Medium	Critical	High	Triangular	Triangular		Cost Engineering	Project Cost & Schedule	Need PDT input on risk reduction measures.
23	2 - Scope and Objectives (SC)	Executive Order 14057, Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability, Dec 2021	Design impact, which could impact scope, cost, and schedule	Future phases are tied to first phase, so design for all phases must fall under same energy scheme. Will this project be impacted? Will there be a waiver due to historic category of buildings? Already doing geothermal and high performance glass. WC: Would have to redo roof (high cost roof). Phase 1...assume impact during design phase - 4 months for funding and 2 months for design changes???	Likely	Negligible	Low	Negligible	Low	N/A -Not Modeled	N/A -Not Modeled		Customer	N/A -Not Modeled	Low risk item.
24	14 - Estimate and Schedule Risks (ES)	Cost Book Price Adjustment	~The estimate is heavily based on the 2016 Cost Book for which material pricing has to be adjusted. ~Building materials since COVID hit have been very volatile with pricing.	The current markup on Cost Book materials is 36%. ENR can provide another data source on how those percentages can vary.	Possible	Significant	Medium	Negligible	Low	Triangular	N/A -Not Modeled		Cost Engineering	Project Cost	Need PDT input on risk reduction measures.
25	16 - Mechanical (ME)	HVAC / Mechanical	~Design refinement of scope/quantities from 65% to 95% ~Controls - lead time issues? (schedule) ~interface between current phase and future phase (schedule) ~Capacity of vertical pipe chases / tight space above ceiling - room for new piping ~Safety risk during demo of high temp heat exchangers ~Encountering abandoned utilities (i.e., wiring/piping) that would need to be removed	Need for temporary chiller near loading dock (east side of building). AECOM did a pretty extensive survey of building, so capacity for new piping should not be an issue. If encountered abandoned pipe with asbestos insulation, it would be a larger schedule impact (covered under asbestos risk item).	Unlikely	Marginal	Low	Negligible	Low	N/A -Not Modeled	N/A -Not Modeled		Mechanical Design	N/A -Not Modeled	Low risk item.
26	2 - Scope and Objectives (SC)	Demolition (other than Unforeseen Sight Conditions or Asbestos Abatement)	~Design refinement of scope/quantities from 65% to 95%	The demolition itself is lower risk. Possibly higher risk in Unforeseen Sight Conditions and/or Asbestos Abatement risk elements. Negligible changes to scope for demolition.	Unlikely	Marginal	Low	Moderate	Low	N/A -Not Modeled	N/A -Not Modeled		Environmental Compliance	N/A -Not Modeled	Low risk item.
27	7 - General Technical Risk (TR)	Other Minor Work Items	~possible user requested changes ~minor scope changes still possible, or refinement of detail in cost estimate	Approx. \$17.4M of work; 5% of that is \$870K, which is marginal cost impact; user requested changes could create minor work changes - still within marginal range; water infiltration on west end of building	Likely	Marginal	Medium	Negligible	Low	Triangular	N/A -Not Modeled		Cost Engineering	Project Cost	Need PDT input on risk reduction measures.
28	21 - Environmental & Cultural/Historical Resources (EC)	HTRW Concerns	~Contaminated soil	risk would depend on location of mains coming out of mech rooms and which mains we are taking out (near stairwells) (could be a two week delay, but there is float in site work activities due to long lead items)	Very Likely	Negligible	Low	Negligible	Low	N/A -Not Modeled	N/A -Not Modeled		Environmental Compliance	N/A -Not Modeled	Low risk item.
29	4 - External Risks (EX)	Bid Competition, Number of Bidders, and Awardable Range	Even with a perfect IGE, the number of bidders and bid competition can affect costs of proposals and an IGE can be awarded as long as it is within 25% of the IGE without profit.	The base estimate assumes profit is 9%. BC: Assume 16% lower than IGE. WC: Assume 16% higher than IGE.	Very Likely	Critical	High	Negligible	Low	Triangular	N/A -Not Modeled		Cost Engineering	Project Cost	Need PDT input on risk reduction measures.
30	4 - External Risks (EX)	Pandemic	Pandemic outbreaks could cause delays to construction or availability of materials.	Lead-time risks or material risks are captured with other risk items but there could be schedule delays if pandemic risks still exist at the time of construction which could cause delays the project. WC: Model as an event risk with 6-12 weeks delays to a project.	Possible	Marginal	Low	Critical	High	N/A -Not Modeled	N/A -Not Modeled		Project Management	Project Cost & Schedule	Need PDT input on risk reduction measures.

Appendix C-5

CSRA Assumptions

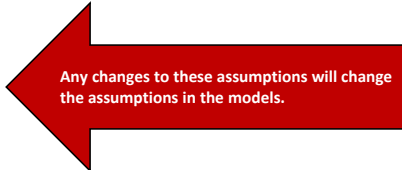
CSRA Assumptions

Risk Matrix

Likelihood of Occurrence	Certain Very Likely Likely Possible Unlikely	Impact or Consequence of Occurrence				
		RELOOK AT BASIS OF ESTIMATE				
		Negligible	Marginal	Moderate	Significant	Critical
		Low	Medium	High	High	High
Low	Medium	Medium	High	High		
Low	Low	Medium	Medium	High		
Low	Low	Low	Medium	Medium		

Likelihood of Occurrence

Likelihood	Low % Occurrence	High % Occurrence
Certain	90%	100%
Very Likely	70%	90%
Likely	30%	70%
Possible	5%	30%
Unlikely	0%	5%
Unrated	<i>Needs Rated</i>	



Percent's above are based on 10 events, and are considered approximate, judgment should be used for final grouping dependent on # of occurrences, project size, flexibility and complexity.

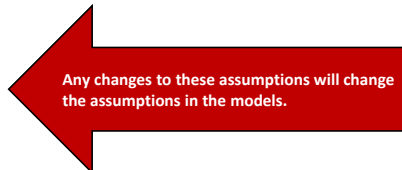
If event occurrence is...	then it's likelihood is thought to be between...
Certain	90% and 100%
Very Likely	70% and 90%
Likely	30% and 70%
Possible	5% and 30%
Unlikely	0% and 5%

Definition
Certain: implies the event has a 90% to 100% chance of occurrence. Rereook at basis of estimate.
Very Likely: implies the event has a 70% to 90% chance of occurrence.
Likely: implies the event has a 30% to 70% chance of occurrence.
Possible: implies the event has a 5% to 30% chance of occurrence.
Unlikely: implies the event has a 0% to 5% chance of occurrence.

Impact or Consequence of Occurrence

This sheet defines what the impacts are based on their cost. This is crucial to define what truly negligible, marginal, moderate, etc. are. Fill this out before the meeting so that you can show what the ranges to be concerned are.

Likelihood	% of Project Cost or Schedule Change	
	per Cost Event Exceeds	per Schedule Event Exceeds
Negligible	0.00%	0.00%
Marginal	0.50%	1.00%
Moderate	1.00%	2.00%
Significant	2.50%	5.00%
Critical	5.00%	10.00%



Percent's above are based on 10 events, and are considered approximate, judgment should be used for final grouping dependent on # of occurrences, project size, flexibility and complexity.

Cost Impact

If event occurrence is...	then it's impact to total project cost is thought to be between...
Negligible	0.00% and 0.50%
Marginal	0.50% and 1.00%
Moderate	1.00% and 2.50%
Significant	2.50% and 5.00%
Critical	Over 5.00%

Definition
Negligible: implies the event has a 0.00% to 0.50% impact to project cost.
Marginal: implies the event has a 0.50% to 1.00% impact to project cost.
Moderate: implies the event has a 1.00% to 2.50% impact to project cost.
Significant: implies the event has a 2.50% to 5.00% impact to project cost.
Critical: implies the event has a greater than 5.00% impact to project cost.

Schedule Impact

If event occurrence is...	then it's impact to total project schedule is thought to be between...
Negligible	0.00% and 1.00%
Marginal	1.00% and 2.00%
Moderate	2.00% and 5.00%
Significant	5.00% and 10.00%
Critical	Over 10.00%

Definition
Negligible: implies the event has a 0.00% to 1.00% impact to project schedule.
Marginal: implies the event has a 1.00% to 2.00% impact to project schedule.
Moderate: implies the event has a 2.00% to 5.00% impact to project schedule.
Significant: implies the event has a 5.00% to 10.00% impact to project schedule.
Critical: implies the event has a greater than 10.00% impact to project schedule.

Cost / Schedule Impact Percentages Converted to Cost / Schedule Ranges

Remaining Base Cost / Schedule	
Base Cost	Base Schedule
\$297,942,392	64.97 MO
Round up to nearest...	
\$250,000	0.50 MO

Impact	Cost Impacts		Schedule Impacts	
	Low Impact	High Impact	Low Impact	High Impact
Negligible	0.00%	0.50%	0.00%	1.00%
Marginal	0.50%	1.00%	1.00%	2.00%
Moderate	1.00%	2.50%	2.00%	5.00%
Significant	2.50%	5.00%	5.00%	10.00%
Critical	5.00%	100.00%	10.00%	100.00%

Impact	Cost Impacts		Schedule Impacts	
	Low Range	High Range	Low Range	High Range
Negligible	\$0	\$1,500,000	0.00 MO	1.00 MO
Marginal	\$1,500,000	\$3,000,000	1.00 MO	1.50 MO
Moderate	\$3,000,000	\$7,500,000	1.50 MO	3.50 MO
Significant	\$7,500,000	\$15,000,000	3.50 MO	6.50 MO
Critical	\$15,000,000	∞	6.50 MO	∞

Appendix C-6

Risk Register Attendance

If Applicable -OR- Available Upon Request

Appendix C-7

Risk Details

Risk No. 1 - Funding Availability for Award of Contract

REF	Risk/Opportunity Event	Cost			Schedule		
		Low Variance	Likely	High Variance	Low Variance	Likely	High Variance
1	Funding Availability for Award of Contract	(\$6,250,000)	\$0	\$12,500,000	-3.0 Months	0.0 Months	6.0 Months

RISK REGISTER RISK LEVEL	Likelihood	Impact (C)	Risk Level (C)	Likelihood	Impact (S)	Risk Level (S)
	Very Likely	Marginal	Medium	Very Likely	Critical	High

Risk Event Description	~ DD1391 is currently is based on 65% cost estimate, but hope to update it. ~ No funding for mods.
PDT Discussions on Impact and Likelihood	Approval of current DD1391 may not happen before anticipated October 2022 award date. If updated, would definitely not meet October 2022 deadline WC: Adjustments to base estimate & schedule may delay project by one fiscal year. The schedule contingency is not modeled since this CSRA is focused on construction risk and not design risk but this risk does impact construction costs if we are delayed a year (so the cost impact is modeled).
Likely	No change from base estimate / schedule.
Low Variance	Assume 750k CY with 3 MO savings.
High Variance	Assume 50% more quantity (1.5M CY) with 6 MO additional time.