Aria Health ED Expansion

Philadelphia, PA

Technical Analysis Report 2

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Executive Summary

General

Technical Analysis Report 2 encompasses a comprehensive study of the Aria Health ED Expansion project through the use of a detailed schedule performed using Primavera P6, a detailed estimate of the building superstructure, and an assemblies estimate of the mechanical, electrical, and plumbing systems. Also included within this report are three separately phased site logistics plans, a general conditions estimate, a study of three unique constructability challenges, as well as an evaluation of LEED and how sustainability relates to the project.

Project Schedule

The Aria Health ED Expansion begins with a project start date of February 25th, 2013 and ends with the first patient day on July 24th, 2014. The schedule consists of a 364 day critical path duration that begins with site prep, the demolition of existing structures, and bulk excavation. The schedule continues with the erection of structural steel, which is phased within 15 separate sections. The building envelope and roof assembly are next, followed by building fitout, which includes MEP rough-in, wall construction, and interior work. The schedule concludes with project closeout, where activities such as MEP equipment start-up, testing & balancing, commissioning, and several different inspections occur. Substantial completion is on June 27th, 2014. The detailed schedule can be viewed in Appendix A.

Detailed Structural Estimate & MEP Assemblies Estimate

A detailed estimate of the concrete building foundation and structural steel was performed on a single, typical bay between column lines E&F and 4&5. All concrete, rebar, welded wire fabric, anchor bolts, formwork, structural steel beams and columns, bolts, shear studs, welded connections, plates, angles, and metal decking were quantified and estimated within that bay. The bay consisted of 1052 GSF of floor area and included level 1, level 2, and roof assembly. The total cost of the building foundation and steel was found to be $44,455.06 or $42.26/SF. This cost/SF value was compared to the actual building cost, which was found to be $40.95/SF. The detailed estimate performed for this analysis deviated by only 3% versus the actual building costs.

An assemblies estimate was also performed for the mechanical, electrical, and plumbing systems for the entire building. Each of the major equipment, most material, all lighting fixtures, receptacles, lavatories, water closets, and roof drains were quantified and priced using RS Means 2013 cost information. The total cost for the mechanical system was found to be $5,389,882.85, where the electrical and plumbing costs were found to be $1,971,016.47 and $1,284,394.25, respectively. Areas of influence for each of the separate mechanical systems can be seen in Appendix B.

Site Layout Planning

The site logistics planning was analyzed through the use of three separate phases of the project. The first phase, titled *Existing Structure Demolition*, looks at the project through the demolition of existing structures that originally attached to the operational hospital; site preparation is also included. The second phase, called *Foundation and Structure*, consists of bulk excavation, foundation, and the erection of the structural steel. Lastly, the third phase analyzed is named *Rough-In and Interiors*, and shows the site logistics for the end of the project and completed site work. Site logistics plans can be viewed in Appendix C.

Executive Summary

General Conditions Estimate

A general conditions and requirements estimate was completed for the Aria Health ED Expansion project where a total was found to be $1,904,840. This sum includes $884,000 for project staff, $155,600 for project reimbursables, $465,240 for general requirements, and $400,000 for bonds, insurance, and taxes. Fictional values were used when determining weekly staff costs, as well as for bonding, insurance, and taxes. The remaining values were determined through different methods, the majority of which from RS Means and speaking with the project team.

Constructability Challenges

An in-depth look at three unique constructability concerns were analyzed after speaking the Aria Health ED Expansion project team. Substantial conversation lead to the review of 1) the transition from old switchgear to new switchgear, 2) shoring operations underneath the existing hospital during excavation, and 3) the rerouting of hospital patients and staff for emergency egress and evacuation. Each concern proposed challenging but successful outcomes, some of which necessitated extensive phasing and planning.

LEED Evaluation

Currently the Aria project is tracking 45 LEED points and is scheduled to achieve LEED Certification. These credits consist primarily of Sustainable Sites, Energy & Atmosphere, Indoor Environmental Quality, Innovation & Design Process, and Regional Bonus Credits. The project team is also tracking an additional possible 8 points, if all goes well.

A detailed review of the project's LEED approach was performed to evaluate how the building could potentially improve its sustainability, as well as benefit from green design. After taking an extensive look at the LEED 2009 Requirements, it was found that a possible 23 points could be added to the tracking list. The majority of these credits are attributed to water efficiency, innovative wastewater design, renewable energy usage, ventilation monitoring, and controllability of building systems.

Detailed Schedule

Commentary

The detailed project schedule that has been assembled for the Aria Health ED Expansion project consists of a 364 critical path duration beginning on February 25th 2013 and ending on July 24th 2014. 145 activities have been inputted and broken up based upon project phase, trade, and scheduled linearly as to reflect how the project is being built in reality. Durations were obtained from the Turner project team, after which activities were combined and placed into Primavera P6 scheduling software.

Demo, Excavation, and Concrete

The project begins with the demolition, excavation, and preparation phase where asbestos abatement, existing structure demo, site preparation, and bulk excavation take place. This phase of work consists of 183 days, the majority of which includes demolition work. Following the first scheduling sequence, concrete placement for levels 1 through 3 will take place. Concrete work includes the basement level 1 retaining wall, foundation walls, all footings, elevator pit, and slab on grade. This section will take 66 days to complete. Level 2 concrete placement consists of all steel column spread footings, high walls, slab on grade, and slab on metal deck. Level 2 will consist of 64 days. Level 3 is the first level to be constructed completely above ground, therefore slab on metal deck is the only concrete left to be poured. Level 3 will only take 5 days to complete.

Structural Steel

The structural steel sequencing has been broken up into 15 separate “derricks”. Each of the derricks are to be erected successively by a two separate truck cranes. Metal deck, welded connections, bolt installation, and shear stud connections will all be done after the columns and beams for their respective derricks have been erected. Each derrick will take between 2 to 8 days to complete, depending on the area of work being completed. Structural steel will take a total of 67 days to complete.

Building Envelope

Also included in the project schedule, 218 days are set aside for the building enclosure. The schedule begins with the installation of the building roof assembly and continues with the North and South elevation studs, sheathing, and blocking. Continuing on, the courtyard elevation studs, sheathing, and blocking are next. The building envelope then continues with each of the three exposed elevation vapor barriers.

The building envelope also includes ArrisCraft Stone paneling, curtain wall & strip windows, metal paneling, face brick, and phenolic panels. The enclosure will then be completed with the installation of the stucco on the roof and framing and metal paneling of the building canopies.

Fitout

Building fitout is broken up into level 1 and level 2, with each level separated into MEP ceiling rough-in, wall construction, and finishes. MEP ceiling rough-in contains the dry and wet HVAC systems, plumbing med-gas, electrical, and fire protection. The wall construction section includes stud partitions, MEP partition rough-in, drywall, and paint. Levels 1 and 2 interiors will be construction simultaneously in order to maximize efficiency. Total building fitout will take 223 days to complete.

Detailed Schedule

Project Closeout

Project closeout consists of the major activities that will come at the end of the project. MEP start-up, medical equipment installation, testing & balancing, commissioning, and several inspections are included, with the addition of substantial completion and the first patient day. A large amount of time is set aside for TAB and commissioning because all of the equipment malfunctions must be worked out prior to project completion. This can take a substantial amount of time when dealing with very sophisticated equipment for a hospital.

The overall detailed schedule can be seen in the appendices section.

Detailed Structural Estimate

Estimate Comparison

Detailed Estimate	Total Cost	GSF	$/SF
Structural Steel	$24,015.87	1052	$22.83
Concrete	$20,439.20	1052	$19.43
Total Structure	$44,455.06	1052	**$42.26**

The above table illustrates the detailed structural estimate performed on one, typical bay of the Aria Health ED Addition. The bay analyzed is between column lines E&F and 4&5. The estimate includes all concrete, rebar, formwork, structural steel members, bolts, shear studs, welded connections, plates, angles, anchor bolts, and corrugated metal decking within that bay. The estimate was performed over 1052 gross square feet of floor area and includes the basement level, first floor, and roof assembly above.

Actual Contract Value	Total Cost	GSF	$/SF
Structural Steel	$1,812,500.00	80087	$22.63
Concrete	$1,467,000.00	80087	$18.32
Total Structure	$3,279,500.00	80087	**$40.95**

Above depicts the actual contract values for the structural steel and concrete trades.

After dividing the total structural steel cost of $24,015.87 by the floor area of 1052 GSF, the cost per square foot was found to be $22.83, which is very close to actual, overall cost per square foot of $22.63. This is not surprising because all connections were taken into account for the estimate.

After diving the total concrete cost of $20,439.20 by the floor area of 1052 GSF, the cost per square foot was found to be $19.43. This differs slightly from the actual value of $18.32/GSF. When estimating an system at a smaller scale, unit costs tend to be slightly higher than a gross estimate of the entire system. This could explain the difference of $1.11/GSF.

Detailed Structural Estimate

Concrete Estimate

Concrete	QTY	UOM	Mat'l	Labor	Equip	Cost	Total Cost
SOG	526.00	SF	1.88	0.88	0.01	2.77	$1,457.02
SOMD	1052.00	SF	1.29	0.86	0.01	2.16	$2,272.32
Foundation Wall	20.14	CY	153	183	15.3	351.3	$7,075.18
Strip Footing	2.00	CY	127	80	0.54	207.54	$415.08
Spread Footing	9.78	CY	179	64	0.43	243.43	$2,380.75

Reinforcing	QTY	UOM	Mat'l	Labor	Equip	Cost	Total Cost
WWF	15.78	CSF	17.35	25.5		42.85	$402.39

Rebar	QTY	UOM	Mat'l	Labor	Equip	Cost	Total Cost
#4	0.04	Ton	1000	760		1760	$70.40
#5	1	Ton	1000	760		1760	$1,760.00
#9	1.1	Ton	1000	445		1445	$1,589.50

Formwork	QTY	UOM	Mat'l	Labor	Equip	Cost	Total Cost
Foundation Wall	408	SFCA	0.74	6.35		7.09	$2,892.72
SOG	24	LF	0.31	2.27		2.58	$61.92
SOMD	24	LF	0.31	2.27		2.58	$61.92

Total Foundation and Accessories	**$20,439.20**
Includes concrete, rebar, and formwork	

The tables to the left include the total concrete for slab on grade, slab on metal deck, the exterior foundation wall, the strip footing beneath, and the spread footing supporting the structural steel columns. Also included is the rebar present inside the footings and wall, as well as the welded wire fabric within the slabs. The formwork shown includes the SFCA for the foundation wall, as well as the exterior edge form for each of the slabs. Only the exterior face was included, because in reality, a much larger area of SOMD would be poured at once. All cost data used was found in R.S. Means 2013.

Formulas used for the estimate include:

$$Cost = Mat'l + Labor + Equip$$

$$Total\ Cost = QTY\ x\ Cost$$

Detailed Structural Estimate

Concrete Take-Off Information

Concrete						
	QTY	**Length**	**Width**	**Depth**	**CF**	**CY**
F60	4	6	6	1.833	263.952	9.78
F30.12	1	18	3	1	54	2.00
Wall	1	24	1.333	17	543.864	20.14
	QTY	**Area**	**Depth**	**CF**	**CY**	
SOG	1	526	0.5	263	9.74	
SOMD	2	526	0.333	350.316	12.97	
Total CY	**55**					

A total of 55 cubic yards was found for the bay analyzed. This was found from the following equations:

$$\frac{(LxWxD)xQuantity}{27} = CY$$

$$\frac{(areaxdepth)xQuantity}{27} = CY$$

Rebar					
Footing	**L/Bar**	**QTY**	**Size**	**# of Footings**	**Tot Length**
F60	5.417	20	#5	4	433.36
F30.12 - Long	18	5	#4	1	90
F30.12 - Wide	3	9	#4	1	27
	L/Bar	**QTY**	**Size**	**# of Walls**	**Tot Length**
Wall	17	24	#5	1	408
	17	24	#9	1	408
	24	34	#5	1	816
Dowels	10	24	#5	1	240
	10	24	#9	1	240

Rebar Totals				
	LF	**LB/FT**	**Tot LB**	**Tot Tons**
#4	117	0.67	78.16	0.04
#5	1897	1.04	1978.95	0.99
#9	648	3.40	2203.20	1.10

WWF	**Area**	**QTY**	**Tot**
6x6 - W2.0xW2.0	526	3	1578
	Area	**QTY**	**Tot**
Metal Deck	526	2	1052

A total of 2.13 Tons of rebar was found by using the footing and rebar schedules within the project documents. Quantities were counted from sections and multiplied by the length/bar, then multiplied by the number of footings present. This then provides the total length of rebar for a specific diameter. WWF was found by taking the area of the bay and multiplying it by the number of floors within that bay.

Detailed Structural Estimate

Steel Estimate

Metals	QTY	UOM	Mat'l	Lab	Equip	Cost	Tot Cost
Steel Members	10	Ton					$15,052.74
Shear Studs	188	EA	0.59	0.83	0.48	1.9	$357.20
Angle - 3/5"x3"x6"L	72	EA	25.5	13.8	0	39.3	$2,829.60
Bolts - A325, 3/4"D	376	EA	2.66	3.34	0	6	$2,256.00
Weld Connections	60	EA	1.05	0.92	0.53	2.5	$150.00
Top Plates - (8) 8"x12"x1/2"	5.33	SF	26.5	0	0	26.5	$141.25
Base Plates - (2) 12"x12"x1/8"	2	SF	6.65	0	0	6.65	$13.30
Base Plates - (2) 20"x20"x1/8"	5.76	SF	6.65	0	0	6.65	$38.30
Anchor Bolts - 3/4"Dx12" L	16	EA	4.89	0	0	4.89	$78.24
Floor Deck - 3", 20 ga, Galv.	526	SF	2.21	0.54	0.05	2.8	$1,472.80
Roof Deck - 3", 20 ga, Galv.	526	SF	2.45	0.45	0.04	2.94	$1,546.44

Tot Cost for 3-Story Bay	**$23,935.87**
Includes 2-Level columns, and 2 levels of beams	

Included in the table to the left includes 4 columns that reach from the spread footing in the basement to the roof level, 8 steel beams (4 per level), and 4 steel beam girders (2 per level). Associated with each of these structural steel members are all connections, complete with steel angles, top and bottom plates, bolts, and welded connections. The corrugated metal decking is also shown, along with the welded shear studs that provide the composite beam and metal deck assembly.

Formulas used for the estimate include:

$$Cost = Mat'l + Labor + Equip$$

$$Total\ Cost = QTY\ x\ Cost$$

Detailed Structural Estimate

Steel Take-Off Information

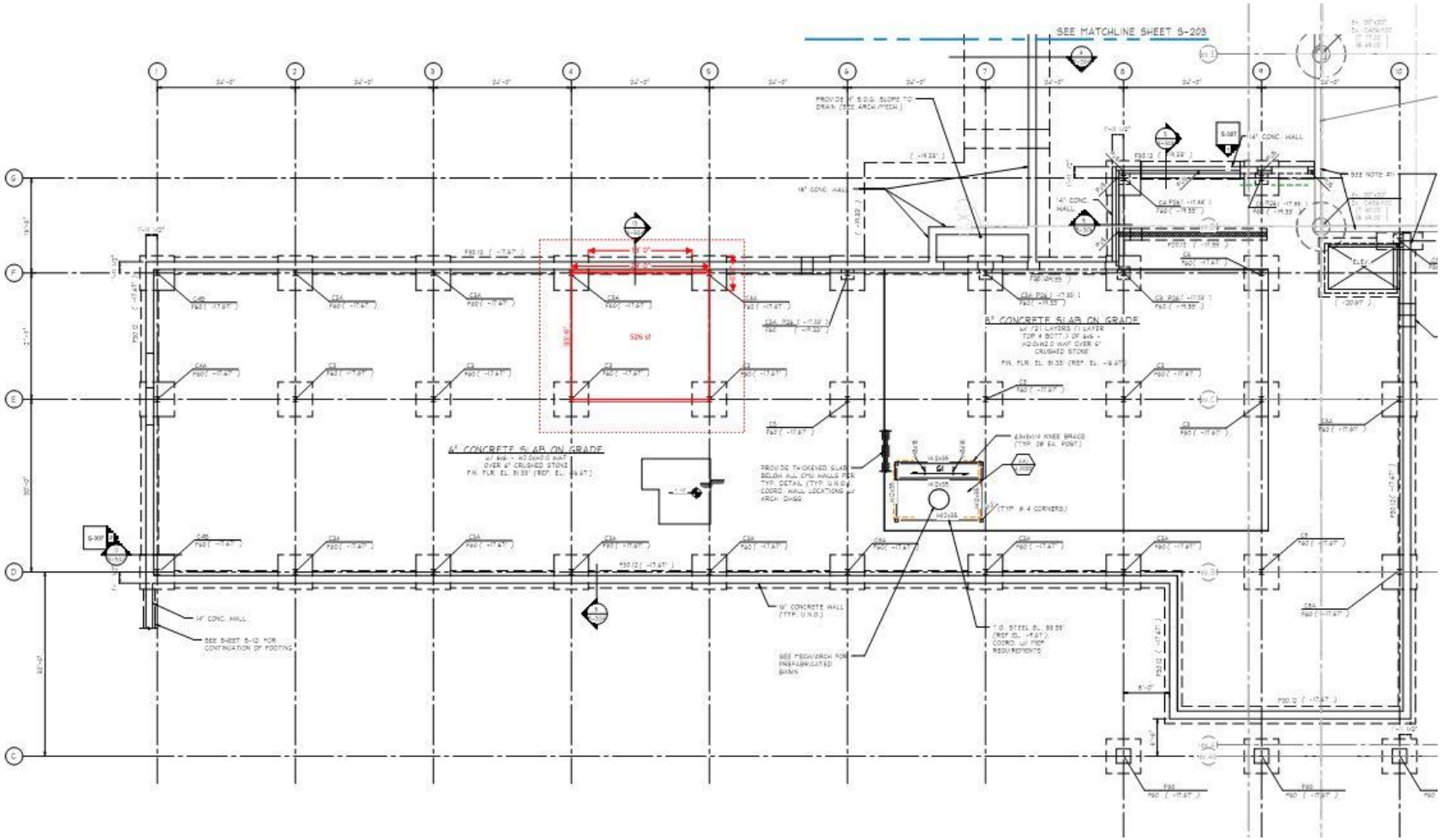
Structural Steel											
Columns	**QTY**	**Web Depth**	**LB/FT**	**Length**	**Tot LB**	**Tons**	**Mat'l Cost**	**Labor Cost**	**Equip Cost**	**Cost**	**Tot Cost**
W10x60	2	10	60	31.667	3800.04	1.90002	97	2.79	1.55	101.34	$3,209.13
W10x60	2	10	60	31.667	3800.04	1.90002	97	2.79	1.55	101.34	$3,209.13
										Subtotal	**$6,418.27**
Beams	**QTY**	**Web Depth**	**LB/FT**	**Length**	**Tot LB**	**Tons**	**Mat'l Cost**	**Labor Cost**	**Equip Cost**	**Cost**	**Tot Cost**
W12x19	2	12	19	21.083	801.154	0.400577	31.5	3.12	1.73	36.35	$766.37
W12x19	4	12	19	21.917	1665.692	0.832846	31.5	3.12	1.73	36.35	$796.68
W16x26	2	16	26	24	1248	0.624	37	2.75	1.52	41.27	$990.48
W18x40	2	18	40	24	1920	0.96	57	4.13	1.74	62.87	$1,508.88
W30x148	2	30	148	21.083	6240.568	3.120284	212	3.42	1.44	216.86	$4,572.06
										Subtotal	**$8,634.47**
										Total	**$15,052.74**

1/2" D, 5 5/16" Long	**QTY**	**Mat'l**	**Labor**	**Equip**	**Cost**	**Tot Cost**
Shear Studs	**188**	$0.59	$0.83	$0.48	$1.90	**$357.20**

Each of the structural steel beams and columns within the bay taken off by finding the quantity and lengths of each. Each beam and column cost was estimated using RS Means by multiplying the unit price by total linear feet for each member. To find the total tons of steel within the bay, the LB/LF was multiplied by the length to total pounds, where the total pounds was divided by 2000lb. There were 10 total tons of structural steel erected for this bay. Shear studs, angles, bolts, welded connections, and base plates were simply quantified from the construction documents, totaled, and priced through RS Means.

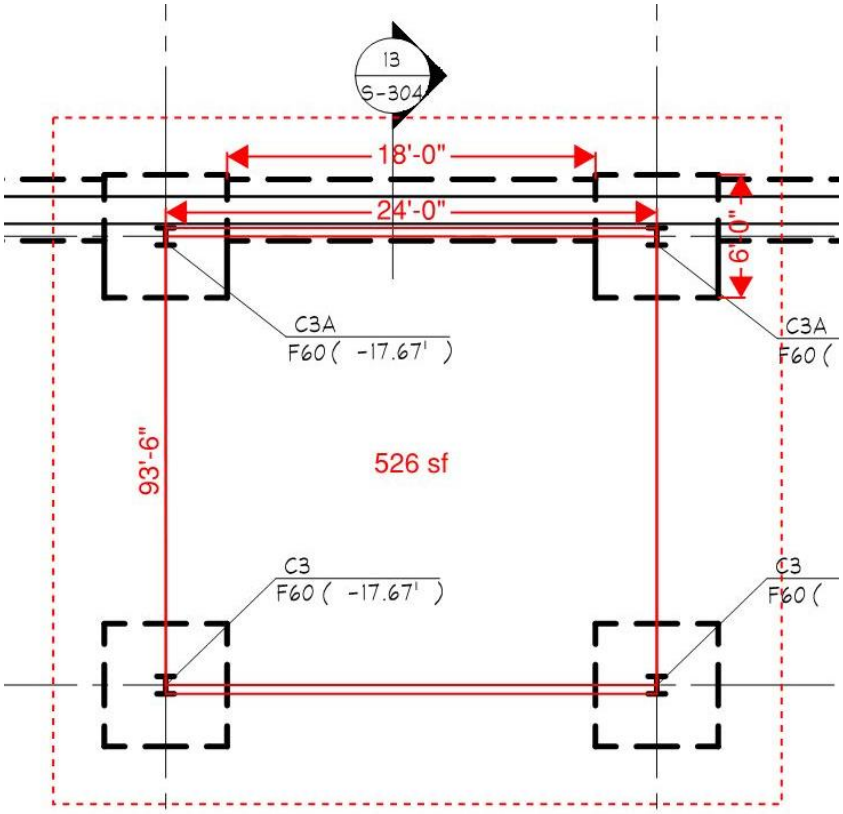
Beam to Column Connection			
Mid Column @ Flange	**QTY**	**# of Connections**	**Tot**
Angle	4	4	16
Bolts - A325 3/4" D	20	4	80
Welded Connections	2	4	8
Mid Column @ Web	**QTY**	**# of Connections**	**Tot**
Angle	4	4	16
Bolts	14	4	56
Welded Connections	4	4	16
Top Column @ Flange	**QTY**	**# of Connections**	**Tot**
Angle	4	4	16
Bolts	20	4	80
Welded Connections	2	4	8
Top Column @ Web	**QTY**	**# of Connections**	**Tot**
Angle	4	4	16
Bolts	14	4	56
Welded Connections	3	4	12
Beam to Girder Connection			
	QTY	**# of Connections**	Tot
Plates	2	4	8
Angle	2	4	8
Bolts	26	4	104
Welded Connections	4	4	16
	QTY	**QTY Columns**	**Tot**
Column Base Plates	1	4	4
Anchor Bolts - 1"	4	4	16

Detailed Structural Estimate



Above is the basement level foundation plan. Shown inside the dashed red line is the bay that has been analyzed.

Detailed Structural Estimate



Above depicts an enlarged foundation plan for bay that has been estimated. To the right is the associated schedules depicting the appropriate footings and columns shown in the plan.

COLUMN FOOTING SCHEDULE

MARK	DIMENSIONS			REINFORCING
	LENGTH	WIDTH	THICKNESS	
F24Φ				(8) #7 VERT. & #3 TIES @ 12" o/c
F40	4'-0"	4'-0"	1'-6"	(6) #5 EWB
F50	5'-0"	5'-0"	1'-8"	(5) #6 EWB
F60	6'-0"	6'-0"	1'-10"	(10) #5 EWB
F66	6'-6"	6'-6"	2'-0"	(6) #7 EWB
F70	7'-0"	7'-0"	2'-2"	(7) #7 EWB
F80	8'-0"	8'-0"	2'-6"	(7) #8 EWB
F90	9'-0"	9'-0"	2'-8"	(7) #9 EWB
F8030	8'-0"	3'-0"	2'-6"	(4) #8 LWB, (7) #8 SWB
F14090	14'-0"	9'-0"	2'-8"	(12) #7 EW T&B

WALL FOOTING SCHEDULE

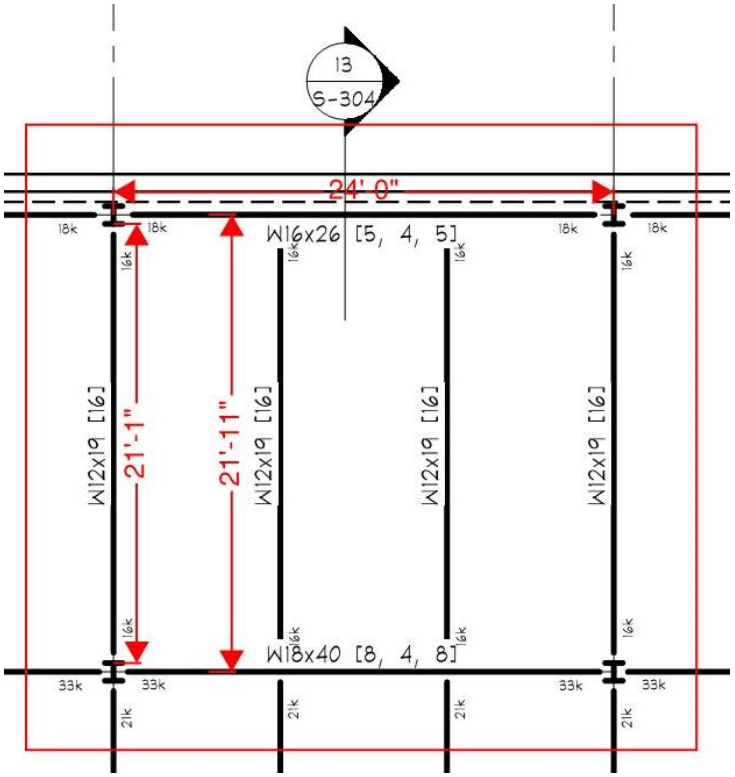
MARK	DIMENSIONS		REINFORCING
	WIDTH	DEPTH	
F20.12	2'-0"	1'-0"	(3) #4 LWB. #4@24" SWB
F30.12	3'-0"	1'-0"	(5) #4 LWB #4@24 SWB

COLUMN SCHEDULE

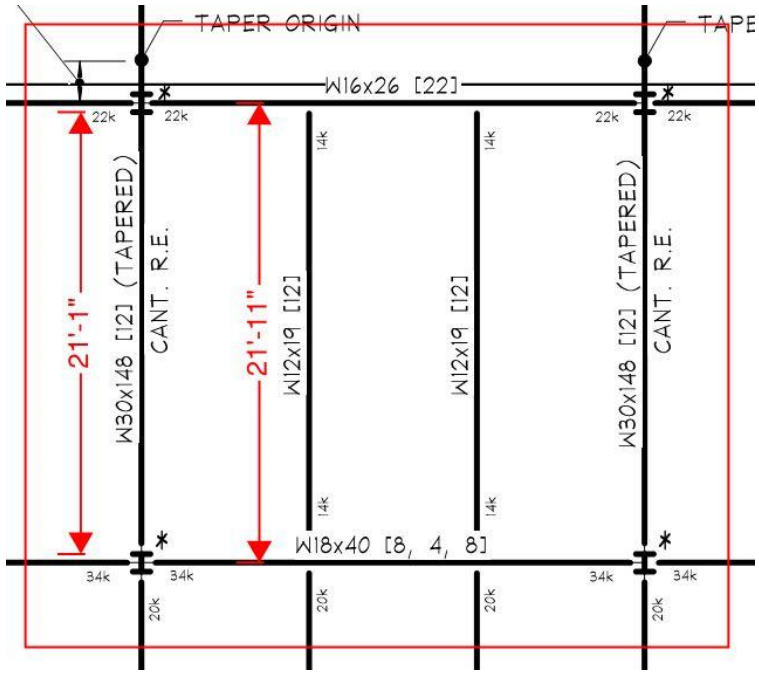
MARK	SIZE	BASE PLATE (*)	ANCHOR RODS (F1554, Gr. 36)
C1	W12x136	1 3/4 x 24 x 2'-0"	(4) 1 1/2"Φ
C2	W10x49	3/4 x 18 x 1'-6"	(4) 3/4"Φ
C3	W10x60	1 1/2 x 20 x 1'-8"	(4) 1"Φ
C3A	W10x60	1 1/2 x 12 x1'-8"	(4) 1"Φ
C4	W10x77	1 1/2 x 20 x 1'-8"	(4) 1"Φ
C4A	W10x77	1 1/2 x 12 x1'-8"	(4) 1"Φ
C4B	W10x77	1 1/2 x 20 x 1'-8"	(4) 1"Φ
C5	HSS8x8x1/2	1 3/4 x 18 x 1'-6"	(4) 1 1/2"Φ
C5A	HSS8x8x1/2	1 3/4 x 12 x 2'-8"	(4) 1"Φ EPOXY ANCHORS (9" MIN. EMBED.)
C6	HSS6x6x5/16	3/4 x 12 x 1'-0"	(4) 3/4"Φ

(*): SEE SHEET S-302 FOR COLUMN BASE PLATE DETAILS.

Detailed Structural Estimate

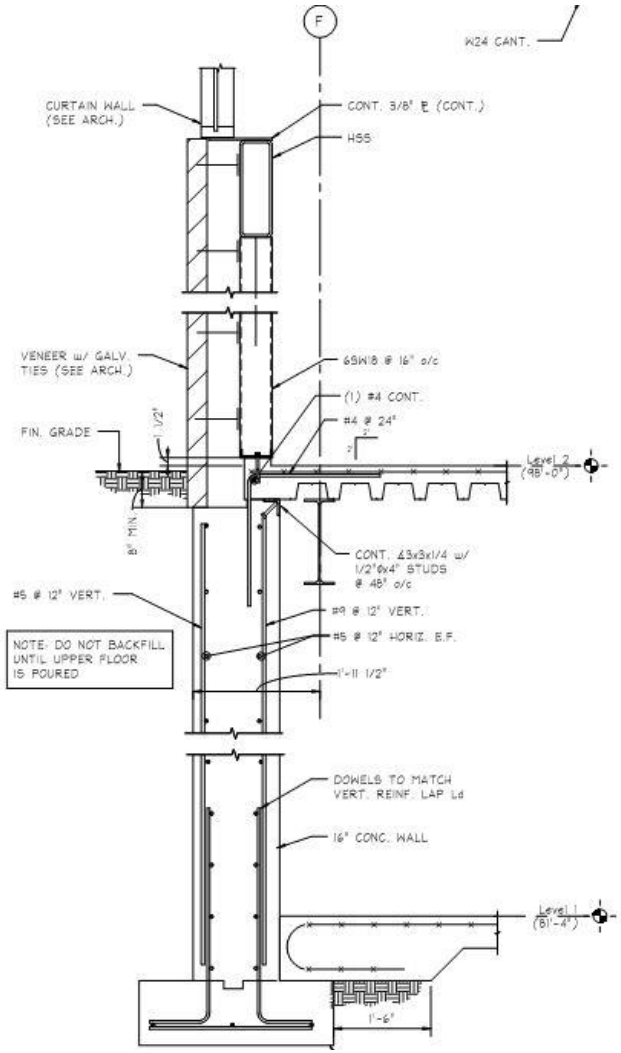


Above shows the steel plan for the first floor level.

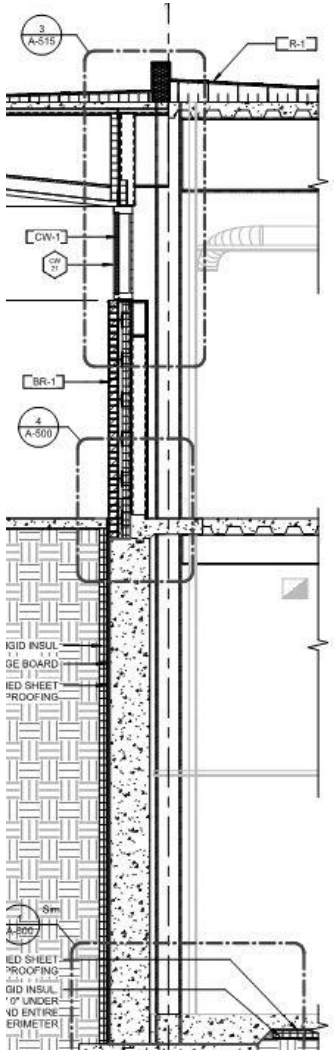


Above shows the steel plan for the roof level.

Detailed Structural Estimate

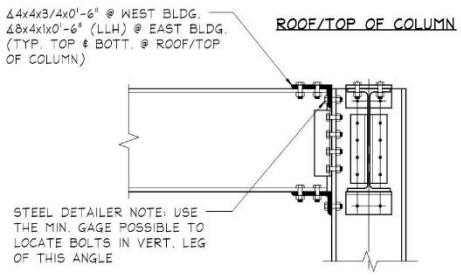


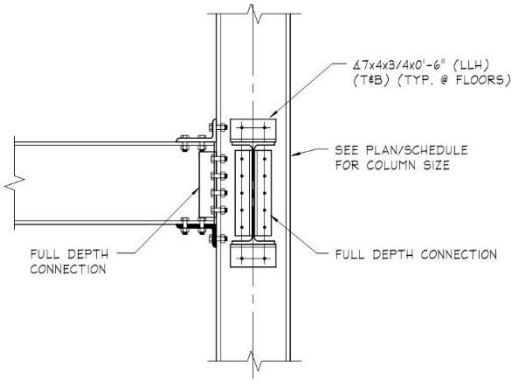
The foundation wall is shown above in a structural wall section.



The foundation wall is shown above in an architectural wall section.

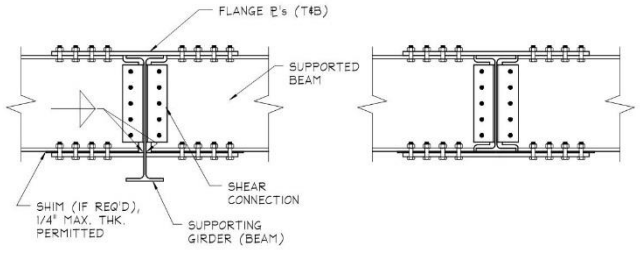
Detailed Structural Estimate



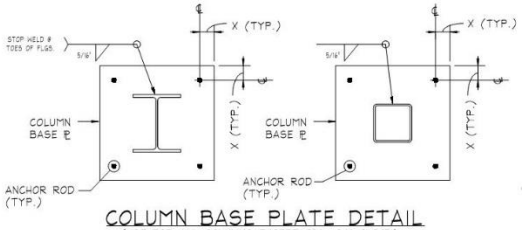


TYPICAL BEAM/GIRDER @ COLUMN FLEXIBLE MOMENT CONNECTION

(TO BE USED @ ALL COLUMN CONNECTIONS UNLESS NOTED OTHERWISE.)



TYPICAL BEAM TO GIRDER MOMENT CONNECTION - FIELD BOLTED

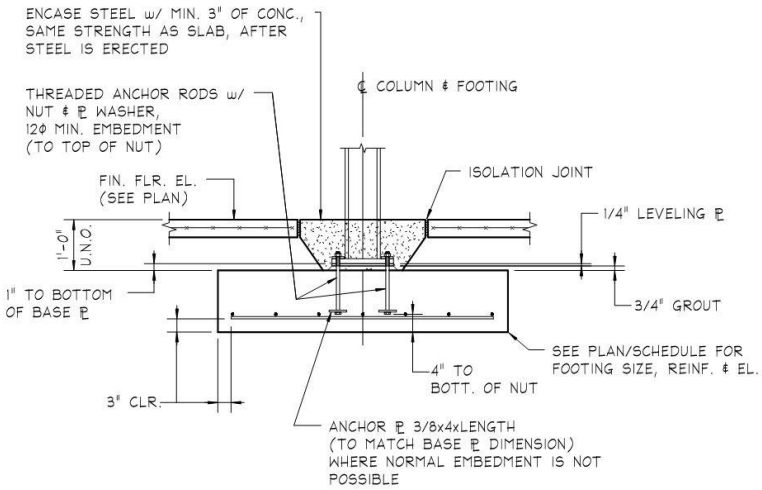


COLUMN BASE PLATE DETAIL

(USE FOR ALL COLUMNS EXCEPT C3A, C4A & C4B)

ANCH. ROD DIA.	DIMENSION 'X'	MIN. PLATE WASHER THICK.	MIN. PLATE WASHER SIZE
3/4"	1 1/2"	1/4"	2"
1"	2 1/4"	3/8"	3"
1 1/4"	2 1/2"	1/2"	3"
1 1/2"	3"	1/2"	3 1/2"
1 3/4"	3 1/4"	5/8"	4"
2"	4"	3/4"	5"
2 1/2"	4 1/2"	7/8"	5 1/2"

The typical details shown are where the connection types were found, along with the quantity of angles, bolts, and welded connections. Thickness of plate connection are also depicted. Rebar type, quantity, and location are can be seen in footing detail, as well as in the section on the previous page. Concrete type and WWF are shown elsewhere.



TYPICAL COLUMN FOOTING WITHOUT PIER

MEP Assemblies Estimate

Estimate Comparison

Assemblies Estimate		
System	**Total Cost**	**Cost/SF**
Mechanical	$5,389,882.85	$67.30
Electrical	$1,971,016.47	$24.61
Plumbing	$1,284,394.25	$16.04
Direct Work Total	**$8,645,293.57**	**$107.95**

The above table illustrates the total mechanical, electrical, and plumbing costs found for the Aria Health ED Expansion project after performing an assemblies estimate. All of the above costs include a fictional 10% for overhead & profit.

Actual MEP Cost		
System	**Total Cost**	**Cost/SF**
Mechanical	$5,393,000.00	$67.34
Electrical	$2,665,000.00	$33.28
Plumbing	$0.00	$0.00
Direct Work Total	**$8,058,000.00**	**$100.62**
*No plumbing cost was giving for actual project		
*Electrical cost above includes fire alarm		

The above table depicts the actual costs for the building mechanical and electrical systems. It should be noted that a plumbing cost of $0 was included in the project GMP. The electrical cost shown also includes the fire alarm system.

After dividing the total mechanical assemblies cost by the building area of 80,087 SF it was found that the mechanical system cost was $67.30/SF. This is extremely close to the actual mechanical cost of $67.34/SF, which is a difference of less than one percent. After dividing the assemblies electrical cost of $1,971,016.47 by the building GSF, it was determined that the Cost/SF was $24.61. This is significantly lower than the actual cost because the fire alarm was not estimated. Performing a plumbing assemblies estimate, it was found that the total building plumbing system was $1,284,394.25. This seems reasonable for an 80,087 SF hospital, however there is nothing with which to compare. An outside source was consulted with to determine if this was adequate, but no answer was received in time for the submission of this report.

MEP Assemblies Estimate

Mechanical Take-Off Information

Mechanical Assemblies Estimate			
TAG	**Area of Influence (GSF)**	**Cost/SF**	**Total Cost**
FTR	10880	$14.40	$156,672.00
FCU	15617	$8.65	$135,087.05
UH	17236	$8.65	$149,091.40
AHU-1	13940	$34.25	$477,445.00
AHU-2	47685	$25.70	$1,225,504.50
AHU-3	47685	$25.70	$1,225,504.50
HV-1	13940	$34.25	$477,445.00
CH/CT	80087	$13.15	$1,053,144.05

Subtotal		**4,899,893.50**
Overhead & Profit	**10%**	**1.10**
Total Cost		**5,389,882.85**
Percent Accuracy to Contract Value		**99.94%**

Formulas used:

$$Total\ Cost = Area\ of\ Influence\ x \frac{Cost}{SF}$$

The mechanical assemblies estimate was performed by first figuring out which systems were present within the building. Next, the area of influence of the respective systems was found (this can be seen in the *Mechanical Influence Areas* Appendix). The Cost/SF of each of the mechanical systems was then found using RS Means Assemblies Cost Info 2013. This Cost/SF was then multiplied by the area of influence to find the total cost for that particular system. All of the total costs were then summed for a subtotal, after which a fictional 10% was applied for O&P.

MEP Assemblies Estimate

Electrical Take-Off Information

Branch Circuits

Branch Circuit Power						
Level	**# Rcpt**	**GSF/1000**	**Rcpt/1000SF**	**Cost/SF**	**SF**	**Total Cost**
1	147	13.94	11	$2.92	13940	$40,704.80
2	758	47.685	16	$3.58	47685	$170,712.30
3	35	18.34	2	$1.79	18340	$32,828.60
				Total Branch Power		**$244,245.70**

Branch Circuit Lighting							
Level	**# Lts**	**GSF**	**Lts/SF**	**X (SF)**	**Lts/X**	**Cost/SF**	**Total Cost**
1	127	13940	0.009110473	400.00	3.64	$15.23	$212,306.20
2	666	47685	0.013966656	400.00	5.59	$12.25	$584,141.25
3	240	18340	0.01308615	400.00	5.23	$12.25	$224,665.00
					Total Branch Lighting		**$1,021,112.45**

To find the building electrical assemblies cost, first each of the building receptacles were counted and totaled for each floor. Each floor's GSF was then divided by 1000 to create a factor in which to use with the RS Means costs. The RS Means Cost/SF was then found along with the Receptacles/1000SF. The Cost/SF was then matched with the building receptacle total, and multiplied by the respective floor's GSF. This then gave the total cost for that floor, including conduit, wire, and receptacles.

Similarly, the total amount of lights per floor was counted and totaled. These totals were then divided by the floor's respective GSF, which then gave the total Lights/SF. This value was then multiplied by a factor "X", which was found to be 400 in RS Means. Then from the Lights/X value, the respective Cost/SF value within RS Means was found and multiplied by the total floor area. Each of the branch lighting circuit costs were totaled. This cost included fixtures, conduit, and wiring.

MEP Assemblies Estimate

Electrical Take-Off Information Continued

Panel Boards, Switchgear, Substation, and Generator

DP-1 Panel	$16,100.00
400A	
480/277V	

CT Panel	$16,100.00
400A	
480/277V	

DP-2 Panel	$25,175.00
800A	
480/277V	

PP-1 Panel	$21,675.00
600A	
480/277V	

Substation	$33,525.00
1200A	
480/277V	

Panels	QTY	Cost/EA	Total Cost
100A	27	3600	$97,200.00
225A	11	6425	$70,675.00
400A	1	9475	$9,475.00
	Total Branch Panels		**$177,350.00**

	Cost/kW	Capacity (kW)	Total Cost
Generator	236.55	1000	**$236,550.00**

Each of the switchgear, control panels, branch panels, and substations were found from the single line diagram within the construction documents. Each of these items were then priced within RS Means according to size and capacity.

The building also includes a 1MW generator which was also priced according to size within RS Means.

MEP Assemblies Estimate

Electrical Take-Off Information continued

Totals and Justification

Direct Electric Cost	**$1,791,833.15**
Cost/SF	**$22.37**
Excluding Fire Alarm	
Actual Contract Value	**$2,665,000.00**
Cost/SF	**$33.28**
Including Fire Alarm	
Percent Accuracy	**67%**
Understandable Due to Exclusion of FA	
Subtotal	**$1,791,833.15**
Overhead & Profit	**1.1**
Total Cost	**$1,971,016.47**
Percent Accuracy	**73.96%**
Fire Alarm	**$693,983.54**
Includes O&P	

The total direct cost found for all electrical equipment, material, and components was $1,791,833.15 or $22.37/SF. After applying a 10% O&P margin, the total cost was found to be $1,971,016.47. This value does not include fire alarm or any low-voltage wiring. Because fire alarm was excluded, this seems like a well-suited price for a 80,087 SF hospital building. For analysis, the total cost for electrical was subtracted from the actual building cost to find a possible value for fire alarm. This value was found to be $693,983.54, which seem viable for a hospital, considering the extensive life safety measures and precautions.

MEP Assemblies Estimate

Plumbing Take-Off Information

Water Closets	QTY	Cost/EA	Total Cost
Level 1	3	$2,290.00	$6,870.00
Level 2	24	$2,290.00	$54,960.00
			$61,830.00

Lavatory	QTY	Cost/EA	Total Cost
Level 1	7	$1,775.00	$12,425.00
Level 2	66	$1,775.00	$117,150.00
			$129,575.00

Roof Drains	QTY	Cost/EA	Total Cost
3"	6	$3,866.00	$23,196.00
4"	16	$5,271.00	$84,336.00
6"	2	$7,032.00	$14,064.00
			$121,596.00

For the plumbing assemblies estimate, each of the major components such as water closets, lavatories, and roof drains were counted and totaled. Each of these were then priced using RS Means cost information, which includes all connection material, labor, and equipment necessary for installation. Next, a rough quantity take-off was performed to find the total length of domestic water, waste, and medical piping throughout the building. These quantities were then multiplied by the Cost/LF of their respective material. It was assumed that all medical and domestic pipe was copper and an average diameter of 1 ½". An additional 40% was added for pipe risers. It was also assumed that waste pipe was Schedule 40 and an average diameter of 4". An additional 40% was added for risers.

	QTY	UOM	Cost/LF	Total Cost
Med Pipe	6207.6	LF	$36.35	$225,646.26
Domestic Pipe	6624.8	LF	$36.35	$240,811.48
				$466,457.74

	QTY	UOM	Cost/LF	Total Cost
Waste Pipe	5881.4	LF	$66.00	**$388,172.40**

Subtotal		**$1,167,631.14**
Overhead & Profit		**1.1**
Total Cost		**$1,284,394.25**

Site Logistics

Existing Structure Demolition

The project begins with the demolition of two major structures and one smaller structure attached to an existing hospital. These structures can be seen on the *Existing Structure Demolition* plan. The site begins where construction traffic enters the hospital campus from Knights road, shown in dark blue. Traffic will continue West and wind around toward the construction site fencing in dark green. It will then continue along the construction site fence, where vehicles can enter the site in one of two separate locations where operable gates stand. To the West of the construction traffic, the first phase of the project site work is present and enclosed by another site fence shown in pink. Below and above the site work, E&S site work modifications will be taking place, along with the deletion of an existing gravel pit. Along the South-West corner of the building site, a widened construction loop road is present for vehicles to have the opportunity to turn around. Inside the building site fence, two truck cranes will be assisting in the demolition of the two major structures. Because they are mobile, they are shown with pink arrows to indicate movement. Past the construction site to the North, the Turner Construction site trailer can be seen in dark blue. Above, the subcontractor trailer complex can be seen as well. At the very North-West area of the site, contractor parking is shown in green hatch. Patient and staff egress areas are also shown in various parts of the site plan, necessary for evacuation in the event of an emergency. An emergency patient route can also be seen in red, leading from the helipad to the emergency room entrance.

Foundation and Structure

After the existing structures have been torn down, excavation and the erection of superstructure can continue. The proposed building addition can be seen in pink hatch on the *Foundation and Structure* site plan. The same truck cranes will assist in the steel erection. Extensive shoring and lagging will be necessary during the excavation and installation of the addition foundation along the existing hospital foundation to prevent collapse and cave-in. Slight modifications to the building construction site fencing are necessary to allow for steel lay down areas.

Construction site traffic still enters though Knights Road to the East and leads up the site to the West. During this phase however, traffic will not curl downward, but head North-West and straight toward the subcontractor trailer complex. As can be seen in light and dark pink, the phase two site work is enclosed in construction site fencing. Each of the patient and staff egress points remain the same, as do the locations of the portable toilets, subcontractor trailers, and contractor parking.

Rough-In and Interiors

Now that the structure has been erected, MEP rough-in, drywall, interiors, and finishes will commence as shown on the *Rough-In and Interiors Phase* plan. The proposed building outline remains in the same location, but with the addition of vertical personnel transport shown in neon green, 3rd level material loading shown in aqua, and new portable toilets shown in brown. Also new to this phase of the project, the addition of a staff parking lot can be shown in dark blue, along with its associate pathways and turnabout. This is the result of the second phase of site work. This parking lot will also serve as a valet parking area for patients entering the existing hospital for treatment. The addition of an infiltration basin can also be seen in green hatch at the South-East corner of the site. All construction traffic routes, trailers, parking areas, and egress points remain the same as last phase.

General Conditions and Requirements

Estimate

Description	QTY	UOM	Unit Cost	Tot Cost	Assumptions and Commentary
Project Staff - *FICTICIOUS COSTS*					
Project Manager	80	Weeks	$4,250.00	$340,000.00	
Superintendent	80	Weeks	$4,100.00	$328,000.00	
Project Engineer	80	Weeks	$2,700.00	$216,000.00	
			Subtotal	**$884,000.00**	
Reimbursables					
Trailor Rental/Trailor Cleaning	20	Months	$650.00	$13,000.00	Includes trailor rental, maid service, and trailor set up
Trailor Utilities and Communication	20	Months	$800.00	$16,000.00	Includes, water, electricity, and telecom to trailer
Computers	3	EA	$800.00	$2,400.00	Assume 3 computers @ $800 ea
Copy Machines/Printers	2	EA	$4,000.00	$8,000.00	Assume 2 copiers/fax/printers @ $4000 ea
Progress Photos - Ariel	20	Sets	$250.00	$5,000.00	Assume 1 set/mo @ $250 set
General Office Supplies	80	Weeks	$400.00	$32,000.00	Includes all paper, writing utensils, envelopes, desks, organizational materials, chairs, etc.
Travel Expenses	80	Weeks	$140.00	$11,200.00	Assume adequate for staff travel expenses
Misc. Staff Expenses	80	Weeks	$200.00	$16,000.00	Assume adequate for misc. staff expenses
Construction Documents - Print/Bound/Organized	1	EA	$10,000.00	$10,000.00	Includes first-time CD printing and supplementary CCDs and ASIs
Project/Communication Software	20	Months	$1,500.00	$30,000.00	Includes Prolog document management, TurnerTalk, email services
Shipping/Mailing Costs	80	Weeks	$150.00	$12,000.00	Assume $150/Wk for traditional mailing services
			Subtotal	**$155,600.00**	
General Requirements					
Jobsite Dumpsters/Trash Removal/Recycling	80	Weeks	$700.00	$56,000.00	7 dumpsters @ $100/Wk
Portable Toilets/Removal	20	Months	$1,200.00	$24,000.00	6 Portable toilets @ $200/Mo
Trailor Toilet/Plumbing	1	EA	$24,000.00	$24,000.00	Costs incurred with trailor hookup and installation of water service
Jobsite Cleaning Supplies	400	Days	$60.00	$24,000.00	Includes brooms, dustpans, cleaning solutions, shopvacs, etc.
Jobsite Cleaning Labor	400	Days	$330.00	$132,000.00	3 laborers @ $110/Day or $13.75/HR
Final Clean-up	1	EA	$67,500.00	$67,500.00	1 time cost given by Turner Construction
Jobsite Safety	20	Months	$1,500.00	$30,000.00	Jobsite Security
Finished Work Protection	20	Months	$1,000.00	$20,000.00	
Winter Protection	25000	SF	$0.59	$14,750.00	Assumed 25,000SF of area open to air needing enclosure, used RS Means cost
Barricades & Railings	2000	LF	$6.18	$12,360.00	
Privacy Screening	2000	LF	$12.00	$24,000.00	Includes jobsite fencing and non-transparent shielding
Fire Extingushers	10	EA	$163.00	$1,630.00	
First Aid Supplies	20	Months	$250.00	$5,000.00	
Inspections	6	EA	$5,000.00	$30,000.00	Assume each jobsite visit costs $5,000 with a total of 6 visits
			Subtotal	**$465,240.00**	
Bonds/Insurance/Taxes - *FICTICIOUS COSTS*	1	EA	$400,000.00	**$400,000.00**	Assume cost is adequate
			Total	**$1,904,840.00**	

General Conditions and Requirements

Commentary

The General Conditions estimate performed for the Aria Health ED Expansion project summed to a total of $1,904,840. This total cost includes $884,000 for staffing, $155,600 for project reimbursables, $465,240 for general requirements, and summary line item for bonds, insurance, and taxes of $400,000. The total actual project general conditions cost is $1,993,410. Although this difference in cost between the general conditions estimate performed and the actual costs is only 4%, deviations can be attributed to differences in staffing rates, unit cost information, or minor missing general conditions items. It should also be noted that the Turner Construction Company did wish to keep actual staffing costs, bonds, insurance, and taxes confidential. Also within the actual project costs, it should be noted that temporary heat was included in the mechanical scope contract. Temporary electricity on-site was also purchased with the electrical subcontract. Because of this, temporary heat and electricity was omitted from the general conditions estimate performed.

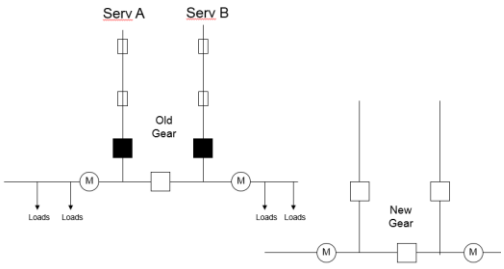
Additionally, all ICRA precautions and measures required for the addition to and renovation of an existing hospital have been purchased through each of the respective trades that perform those measures. Each subcontract includes line items for the procurement of ICRA.

Constructability Challenges

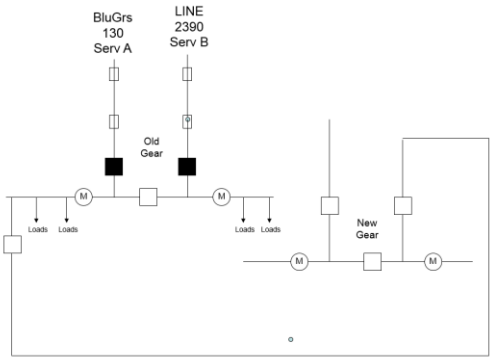
Challenge #1 – Transition from Old Switchgear to New Switchgear

One of the biggest challenges that the Aria Health ED Expansion project team faced during the early stages of construction consisted of the transfer of two incoming medium voltage services from the old building switchgear to the new switchgear. Because the existing hospital had to remain operational, service transfer had to be phased successfully in order for the building loads to continue to receive power. The transition sequence occurred as follows:

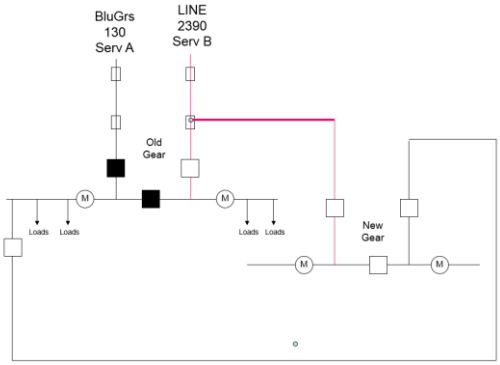
1. Install new gear and commission



2. Connect service A feeder from old to new switchgear

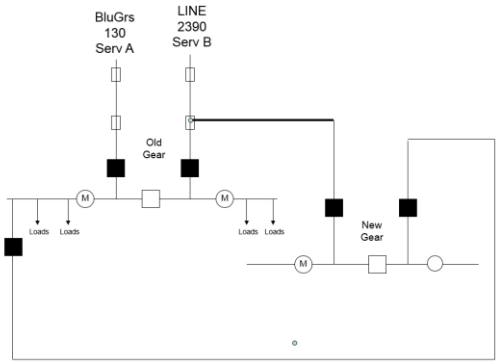


3. Connect new gear to service B using a 3-way splice

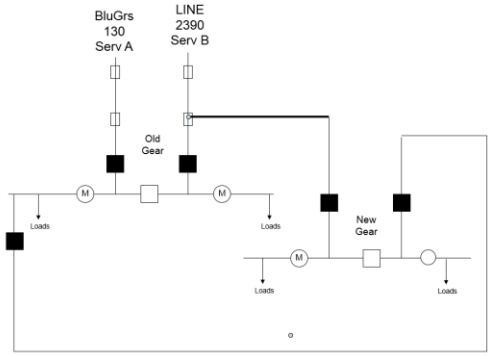


Constructability Challenges

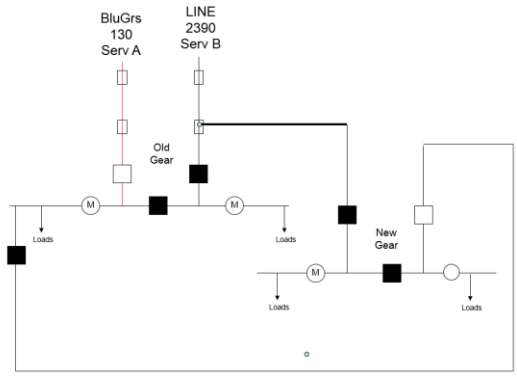
4. Energize service B to new switchgear
5. Energize and phase out service A feeder to new switchgear
6. Disable new service A PECO meter



7. Transfer building loads over a 3 week period

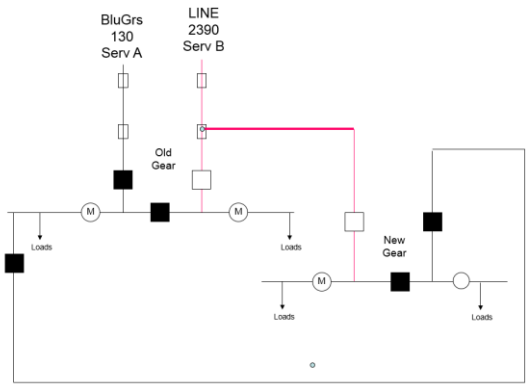


8. During transition – service A will trip breaker
9. Both switchgears transfer
10. New switchgear bus A will then be unmetered
11. Manual retransfer to split on new switchgear to restore proper electricity metering
12. New switchgear will not be parallel on restore with fuse protection

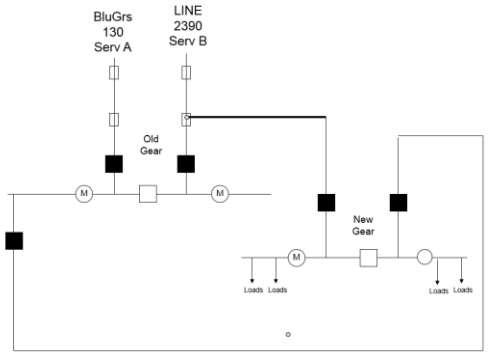


Constructability Challenges

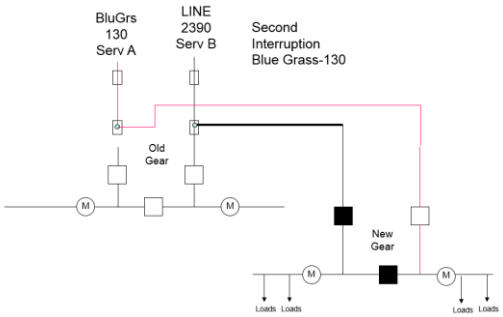
13. During transition – service B will trip breaker
14. Both switchgear will transfer
15. New bus B loads will become double metered
16. Manual retransfer will not correct double meter issue
17. New switchgear will not be parallel on restore with fuse protection



18. Transfer building loads over 3 week period

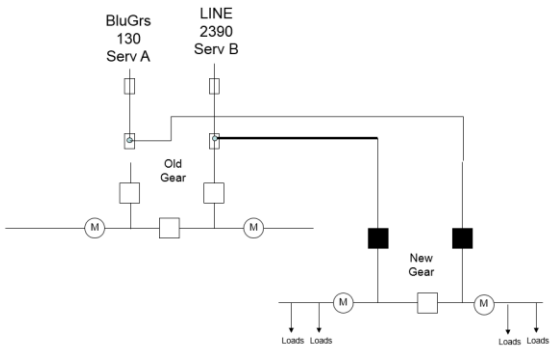


19. De-energize service A
20. Disconnect service A from old switchgear
21. Disconnect old switchgear from new switchgear
22. Reactivate PECO meter on new service A bus
23. Connect service A cable to new switchgear

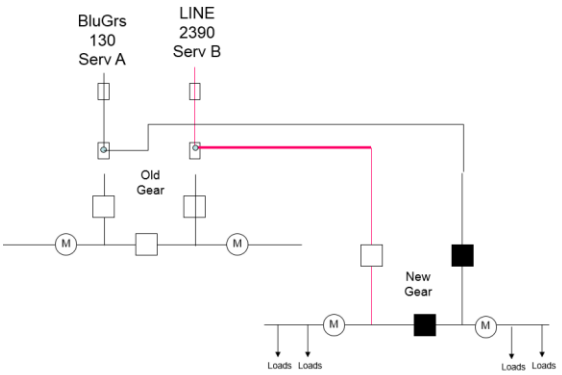


Constructability Challenges

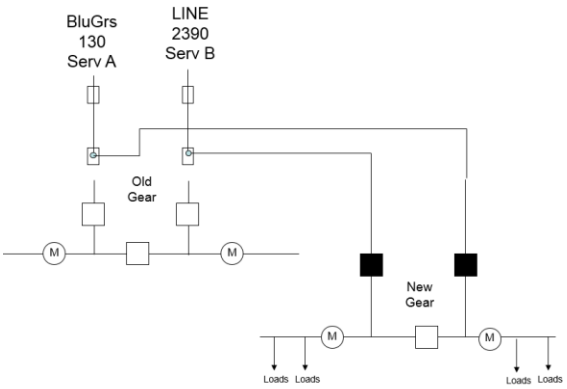
24. Energize and phase out
25. Service A now active to new switchgear



26. Break 3-way splice on service B
27. Disconnect old switchgear from service B



28. Energize and phase out service B to new switchgear

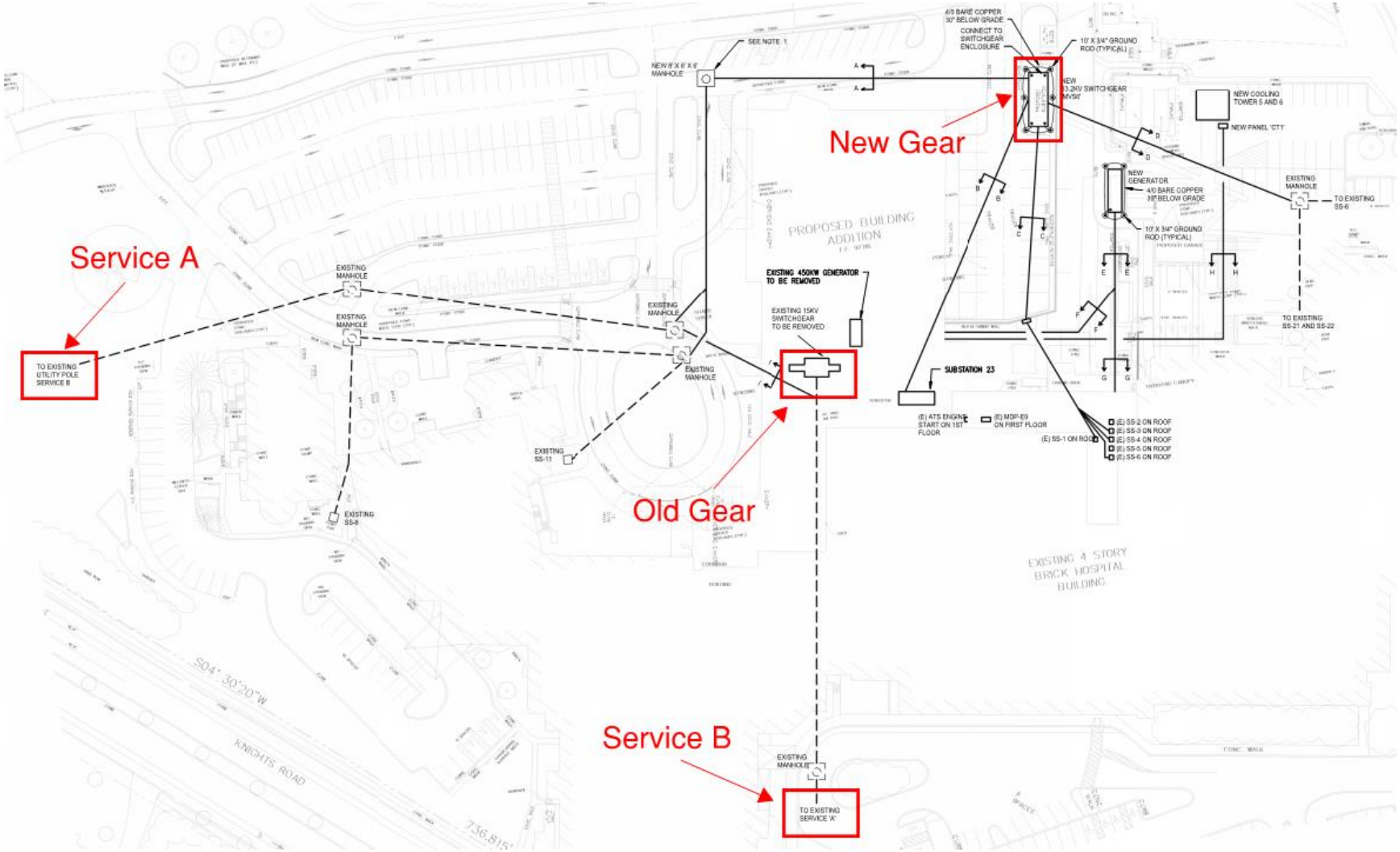


TRANSITION COMPLETE

*Single line graphics provided by Patrick Kershner of Turner Construction Company

*Electrical site plan can be seen on next page

Constructability Challenges



Electrical Site Plan

Constructability Challenges

Challenge #2 – Shoring Operations under Existing Hospital

After the demolition of the existing structures, excavation for the new emergency department addition could commence. In order to do this, the project team was required to perform extensive soil retention strategies around the areas of the operational hospital to prevent collapse and cave-in. Soldier beams and lagging were used heavily along the building perimeter line shown in red below. After conversations with the project team, this method seemed to be the best choice considering the tightly spaced area that excavation was necessary. If the new building were to be built farther away from the existing hospital, sloping or stepping back the soil could have been possible. This was found to be unsatisfactory considering the site conditions.

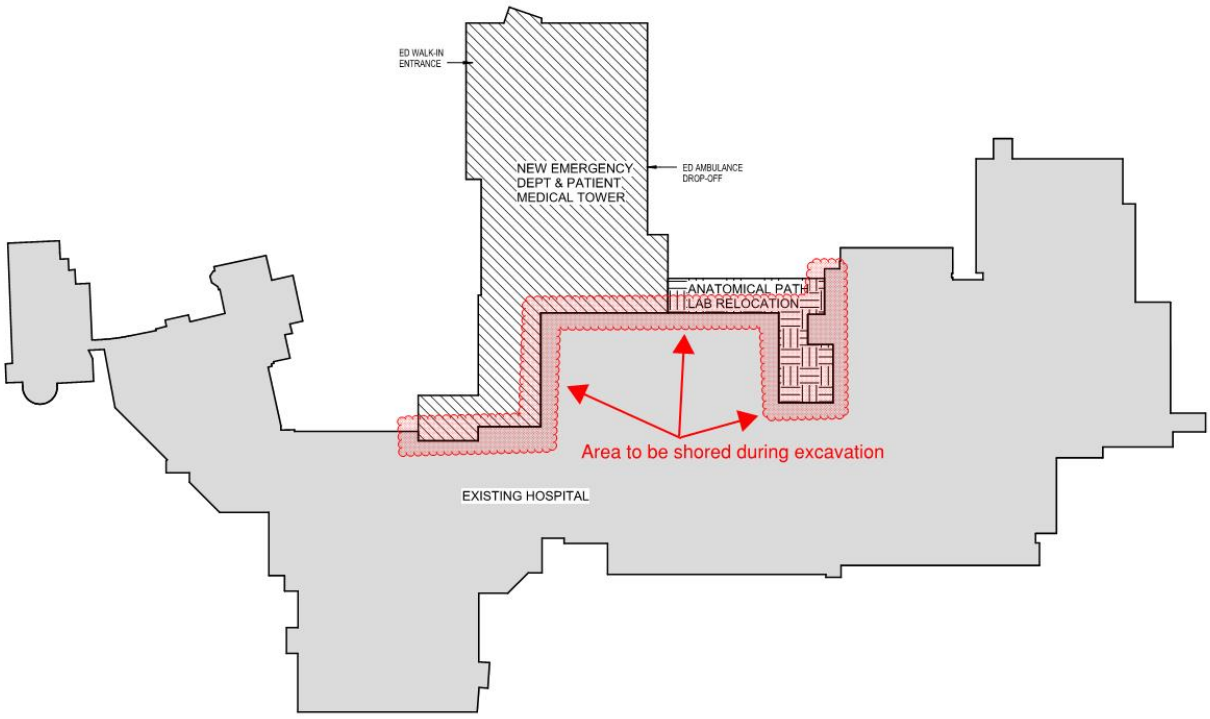


Diagram depicting shoring operations

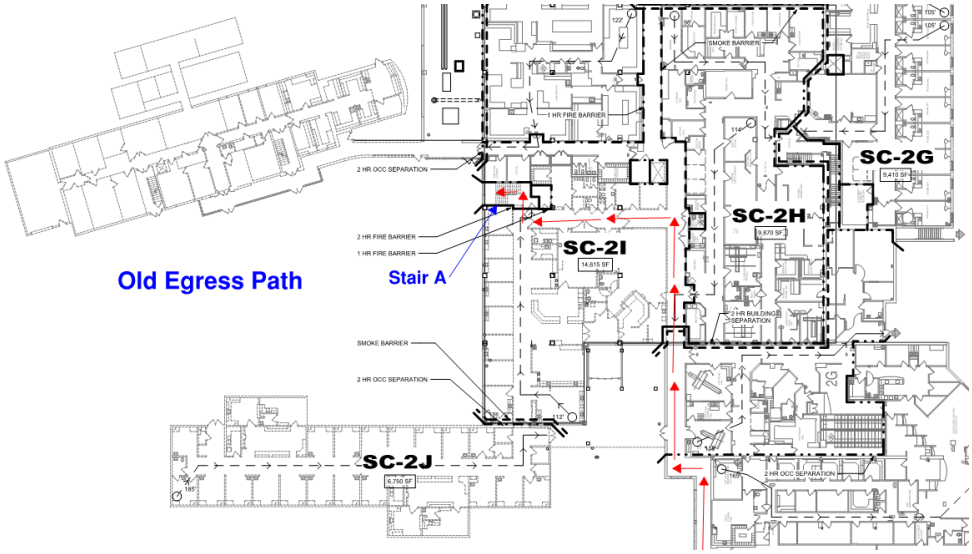
Reference Site plan for building orientation

Constructability Challenges

Challenge #3 – Rerouting of Patient and Staff Egress

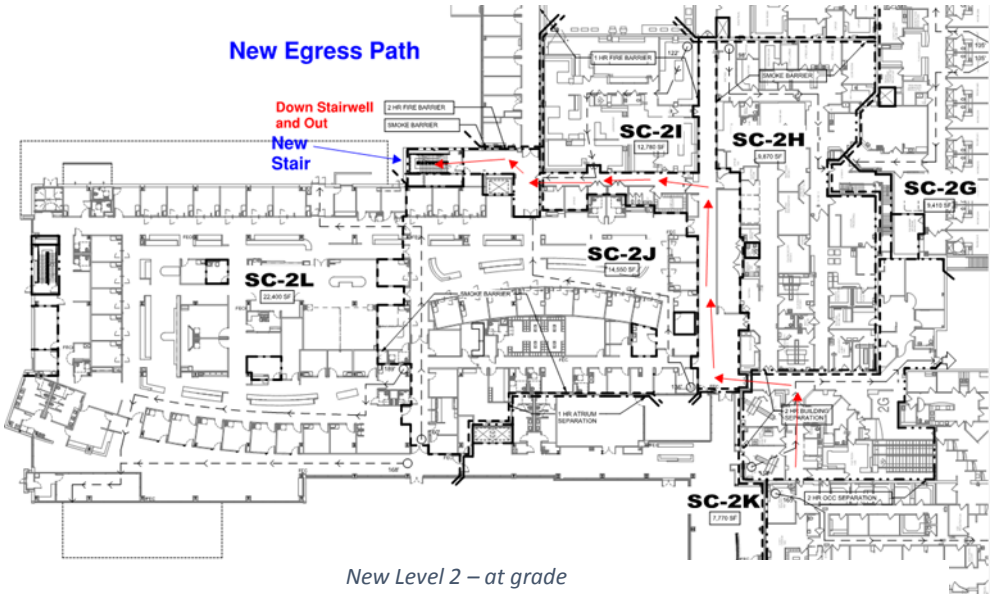
Background Information

Before any demolition or excavation occurred in the area of the proposed addition, patients and staff had an unobstructed path of emergency egress out of the building at grade on level 2. As depicted by the red arrows in the plan below, patrons would follow the main vertical corridor from the O.R. areas, turn left, and exit the building through stair tower A.



Old Level 2 – at grade

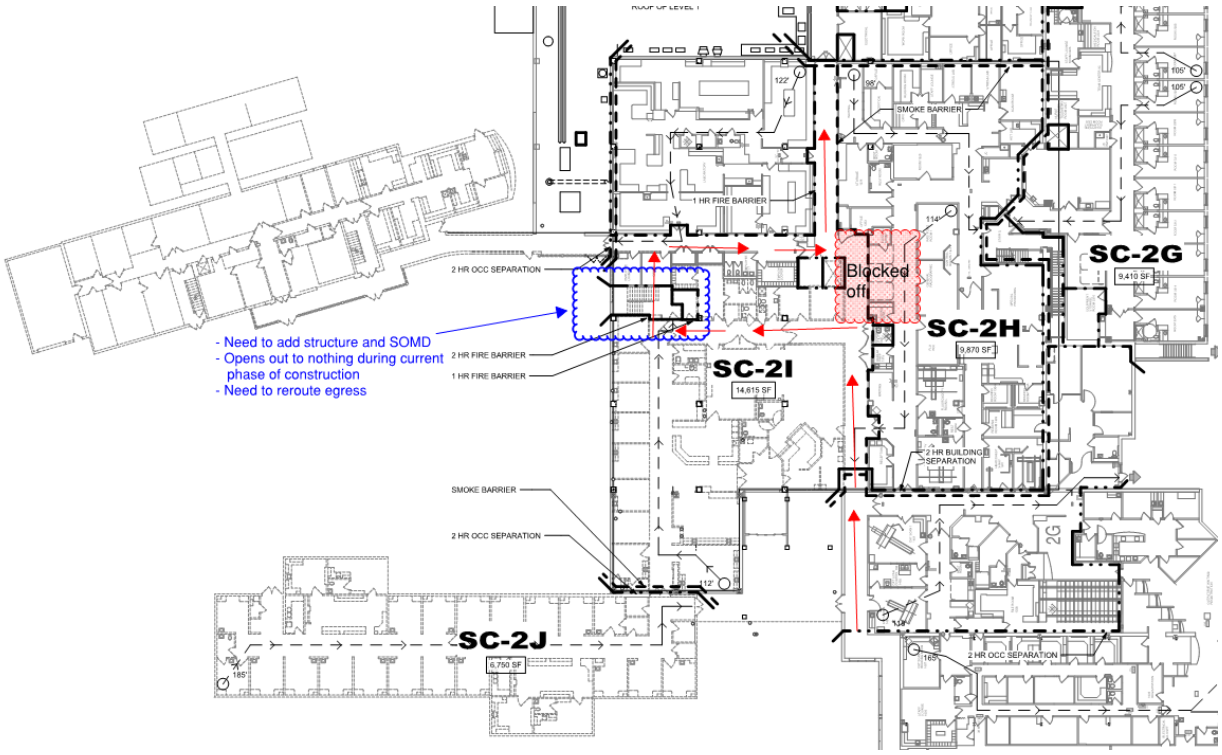
After the new emergency department is constructed, patrons will be able to follow a similar path along the red arrows, turning left, through where the old stair tower A used to be, into the ED addition, into the newly built stair tower, and out of the building.



New Level 2 – at grade

Constructability Challenges

After the demolition of the existing structures and during the excavation of the new building, the project team discovered that the level 2 egress exit will open right over top of a very large hole in the ground. Also, during demolition and renovation of the existing hospital interiors, the stair tower was no longer accessible. Old stair tower A will be filled in concrete slab on metal deck, after additional structure has been put in place beneath it. On the North side of stair tower A is an existing wall, on the other side of which sits an office space. This wall and office space will be torn down in order to create a temporary path of egress for hospital patients and staff. The temporary, revised egress route will follow the red arrows as shown in the figure below. Patrons will follow the vertical corridor from the O.R. areas, turn left toward the old stair tower A, travel North through the old existing wall and office space, turn right, and then up and out to other areas of the hospital. The path of egress from there is yet to be determined.



Revised, temporary level 2 egress path

LEED Evaluation

Current LEED Tracking

The Aria Health ED Expansion project is scheduled to achieve a LEED Certification with 45 probable points and 8 possible. The majority of these points are accomplished through Sustainable Sites, where the project team is tracking 22 probable points, with the addition of 1 possible point. The remaining points consist of 3 probable and 4 possible from Energy & Atmosphere, 5 probable and 1 possible from Materials & Resources, 7 probable and 2 possible from Indoor Environmental Quality, 6 probable from Innovation & Design Process, and lastly, 2 probable from Regional Bonus Credits. If all possible points are received, the project has the opportunity for LEED Silver. The LEED credit titles and associated point breakdown can be seen in Table 1.

Possible Improvements

There are many opportunities for improved green design and overall sustainability within the Aria Health ED Expansion. After careful examination of LEED 2009 for New Construction and Major Renovations, it was found that the most viable options for improvement consist of Water Efficiency, Energy & Atmosphere, and Indoor Environmental Quality, for a total of 23 additional points. If each of the new possible LEED credits were implemented, the sum of LEED points would equate to 76, or LEED Gold. Each of the LEED credit titles, requirements, and implementation descriptions can be seen in Table 2.

Analysis

Water Efficiency

Water Efficiency offers 10 additional points for the LEED credits chosen. The first credit to be analyzed is Water Efficient Landscaping. The requirements for this include the need to reduce or eliminate potable water consumption for irrigation use, which is quite possible through the use of storm water reclamation, recycled gray water, or utilizing plant species that do not require irrigation. Rainwater conductors throughout the building have the potential to transport water to collection basins, where it would be stored and then pumped for irrigation. Another possible addition to this system is to collect the irrigation water underneath the green space through a French drain-type collection pipe, to be pumped back to the original collection basin. Some losses would occur due to the utilization of water by the irrigated plants and grasses. This would pose many potential cost increases, however, with the additional piping, storage bins, and pumps required for operation.

The second Water Efficiency credit to be investigated is Innovative Wastewater Technologies, where the goal is to reduce 50% of the buildings potable water use for sewage conveyance or treat 50% of building wastewater to tertiary standards. This credit offers 2 points is easily attainable through the installation of low-flow water closets and faucets, as well as zero-flow urinals. There are also several packaged nutrient removal systems and high-efficiency filtration systems that could be used in conjunction with a reverse osmosis deionization system (RODI). This equipment can be quite costly, but could provide much water saving benefit.

Additionally, Water Use Reduction credits are also available, after a water savings of 30-40% against the building baseline is achieved. These credits could be possible after employing the above stated implementation strategies.

LEED Evaluation

Energy & Atmosphere

Through the use of On-Site Renewable Energy, a minimum of 1 point and a maximum of 7 points are possible. Building energy usage must be calculated prior to optimizing energy performance through supplementary on-site sources. A possible energy reduction from 1-13% can be reached through many means including solar, wind, geothermal, hydro, biomass, or biogas strategies. All energy production on-site must be clean and non-polluting. The equipment and material necessary for these is extremely expensive, but special attention must be paid to the energy cost payback period. It must also be noted that these renewable electricity generators require specialized equipment such as A/C converters because the electricity produced will be D/C. However, geothermal heat transfer is a very efficient mechanism for heating and cooling, therefore could be a strongly viable option for supplementary air conditioning. The addition of a geothermal piping loop would prove very expensive considering the specialized labor and equipment involved with installation. This would also cause extensive re-design work by the engineer, which would also come with added cost.

The second Energy & Atmosphere credit to be considered is with the implementation of Enhanced Commissioning which provides to opportunity for 2 points. This credit would require early project involvement with a third-party commissioning agent hired by the owner. This agent would review and assess the building design before the construction document phase to scrutinize the design for commissioning purposes. Other activities to be performed by the agent include commissioning design review, submittal review, and a systems manual to be handed to the owner following commissioning completion.

The third option for an additional 2 points requires a contract by the owner to ensure at least 35% of the building's electricity is purchased from renewable resources. This could most easily be accomplished by using the Green-e Energy program. Green-e guidelines are most applicable for this credit, however renewable energy certificates (RECs), tradable renewable certificates (TRCs), green tags, or any other forms of sustainable power that comply with Green-e technical requirements are useable.

Indoor Environmental Quality

Indoor air quality is an important aspect of building mechanical design. Ventilation proves crucial inside a space where many people will be congregating, especially in areas where infection and disease control are of utmost concern. The Outdoor Air Delivery Monitoring credit could provide 1 point to LEED certification. CO_2 monitoring devices provide the best opportunity to measure the necessary outside air input within a space. These sensors would be required to sound an alarm to the BAS or the building operator after CO_2 levels deviate by 10% outside of the design values. This alarm would then signal a possible deficiency the building mechanical system prompting necessary action. The CO_2 sensors would add cost to the building controls system, but provide strong benefits.

The final LEED credit analyzed consists of Controllability of Lighting Systems, which offers 1 point. A 90% minimum of building occupants must be provided individual lighting controls for task needs. Any areas of shared spaced would require adjustments for group preferences. The addition of task lighting must also be managed as not to increase the overall building energy usage.

LEED Evaluation

Owner Perspective

After speaking with Turner personnel, it became evident that the overall LEED expectations of the owner are being met by the project team. The construction manager is tracking all possible points as procured during the preconstruction process. Even though the project is tracking LEED Certification, Aria believes that the clinical needs of the hospital come first and foremost before sustainability. The patient, staff, and administrative needs are most important, which can prove quite costly considering the specialized medical and communication equipment necessary to function as an emergency department.

LEED Evaluation

Current LEED Credits		
Credit Title	**Probable Points**	**Possible Points**
Sustainable Sites		
Site Selection	1	
Development Density & Community Connectivity	5	
Brownfield redevelopment	1	
Alternative Transportation, Public Transportation Access	6	
Alternative Transportation, Bicycle Storage & Changing Rooms	1	
Alternative Transportation, Low-Emitting & Fuel Efficient Vehicles	3	
Alternative Transportation, Parking Capacity	2	
Site Development, Maximize Open Space	1	
Stromwater Design, Quantity Control	1	
Stromwater Design, Quality Control	1	
Light Pollution Reduction		1
Sustainable Site Subtotal	**22**	**1**
Energy & Atmosphere		
Optimize Energy Performance		4
Enhanced Refrigeration Manageent	2	
Measurement & Verification	1	
Energy & Atmosphere Subtotal	**3**	**4**
Materials & Resources		
Construction Waste Management	2	
Recycled Content	2	
Regional Materials	1	1
Materials & Resources Subtotal	**5**	**1**
Indoor Environmental Quality		
Increased Ventilation		1
Construction IAQ Management Plan, During Construction	1	
Construction IAQ Management Plan, Before Occupancy		1
Low-Emitting Materials, Adhesives & Sealants	1	
Low-Emitting Materials, Paints & Coatings	1	
Low-Emitting Materials, Flooring Systems	1	
Controllability of Systems, Thermal Comfort	1	
Thermal Comfort, Design	1	
Thermal Comfort, Verification	1	
Indoor Environmental Quality Subtotal	**7**	**2**
Innovation & Design Process		
Exemplary Performance, Maximize Open Space	1	
Exemplary Performance, Construction Waste Management	1	
Innovation in Design, Low-Emitting Materials, Walls & Ceilings	1	
Innovation in Design, Resource Use, Design for Flexibility	1	
Innovation in Design, Education and Outreach Program	1	
LEED Accredited Professional	1	
Innovation & Design Process Subtotal	**6**	**0**
Regional Bonus Credits		
SSc3, Brownfield Redevelopment	1	
SSc5.2, Site Development, Maximize Open Space	1	
Regional Bonus Credits Subtotal	**2**	**0**
Total	**45**	**8**

Table 1

LEED Evaluation

Possible LEED Credits			
Credit Title	**Requirements**	**Description of Possible Integration**	**Points**
Water Efficiency			
Water Efficient Landscaping	1. Reduce potable water consumption for irrigation by 50% from a calcluated midsummer baseline. (2 Points) 2. No potable water use for irrigation (4 Points)	1. Reductions can be attibuted to plant species, irrigation efficiency, use of captured rainwater, use of recycled rainwater, use of treated and conveyed water by a public agency for nonpotable uses. 2. Use of only captured rainwater, recycled wastewater, recycled graywater, or treated and conveyed water from public agency **-or-** landscaping that does not require permanent irrigation systems.	2 to 4
Innovative Wastewater Technologies	1. Reduce potable water use for buildings sewage conveyance by 50% through the use of water conserving fixtures or nonpotable water. 2. Treat 50% of wastewater on-site to tertiary standards. Treated water must be infiltrated or used on-site.	1. Low-flow water closets, urinals, captured rainwater, recycled graywater, on-site or municipally treated wastewater. Reuse of stormwater or graywater for sewage conveyance or on-site mechanical water. 2. Packaged nutrient removal systems, constructed wetlands, and high-efficiency filtration systems.	2
Water Use Reduction	Strategies that in aggregate use less water than the water use baseline calculated for the building (not including irragation). Savings of: 30% (2 points), 35% (3 Points), and 40% (4 points)	See commercial fixtures, fittings, and appliances and current baselines table from LEED 2009.	2 to 4
		Water Efficiency Subtotal	**10**
Energy & Atmosphere			
On-Site Renewable Energy	Use on-site renewable energy systems to offset building energy costs. Calculate project performance by expressing the energy produced by the renewable systems as a percentage of the building's annual energy cost and use: 1% (1 credit), 3% (2 credits), 5% (3 points), 7% (4 points), 9% (5 points), 11% (6 points), and 13% (7 points).	Assess the project for nonpolluting and renewable energy potential including, solar, wind, geothermal, low-impact hydro, biomass, and bio-gas strategies. Take advantage of net metering with local utility.	1 to 7
Enhanced Commissioning	Implement the commissioning process early in the design process, by contracting an agent before the construction document phase to review and assess all commissioning process activites.	Best to contract agent directly to owner, but contracting to design or CM firm is acceptable. Possible activies include: commssioning design review, commissioning submittal review, and a systems manual.	2
Green Power	Engage in at least a 2-year renewable energy contract to provide at least 35% of the building's electricity from renewable resources.	Utilize Green-e Energy program. Renewable energy certificates (RECs), tradable renewable certificates (TRCs), green tags, and other forms of green power that comply with the technical requirements of the Green-e Energy program may be used to document compliance with this credit.	2
		Energy & Atmosphere Subtotal	**11**
Indoor Environmental Quality			
Outdoor Air Delivery Monitoring	Install permanent monitoring systems to ensure that ventilation systems maintain design mimimum requirements. Configure all monitoring equipment to generate an alarm when airflow values or CO2 levels vary by 10% of more from the design values via either BAS alarm to the building operator or a visual or audible alert to the building occupants.	Install CO2 and airflow measurement equipment and feed the information to the HVAC system and/or BAS to trigger corrective action. If such automatic controls are not feasible with the building systems, use the measurement equipment to trigger alarms that inform building operators or occupants of a possible deficiency in OA delivery.	1
Controllability of Systems - Lighting	Provide individual lighting controls for 90% (minimum) of the building occupants to enable adjustments to suit individul task needs and preferences. Provide lighting system controls for all shared multi-occupan spaces to enable adjustments that meet group needs and preferences.	Design the building with occupant controls. Provide ambient and task lighting while managing the overall energy use of the building.	1
		Indoor Environmental Quality Subtotal	**2**
		NEW Possible Points	**23**
		Current Possible Points	8
		Current Probable Points	45
		Total Points	**76**

Table 2

LEED Evaluation

Calculate the baseline according to the commercial and/or residential baselines outlined below.[1] Calculations are based on estimated occupant usage and must include only the following fixtures and fixture fittings (as applicable to the project scope): water closets, urinals, lavatory faucets, showers, kitchen sink faucets and pre-rinse spray valves.

Commercial Fixtures, Fittings, and Appliances	Current Baseline
Commercial toilets	1.6 gallons per flush (gpf)* Except blow-out fixtures: 3.5 (gpf)
Commercial urinals	1.0 (gpf)
Commercial lavatory (restroom) faucets	2.2 gallons per minute (gpm) at 60 pounds per square inch (psi), private applications only (hotel or motel guest rooms, hospital patient rooms) 0.5 (gpm) at 60 (psi)** all others except private applications 0.25 gallons per cycle for metering faucets
Commercial prerinse spray valves (for food service applications)	Flow rate ≤ 1.6 (gpm) (no pressure specified; no performance requirement)

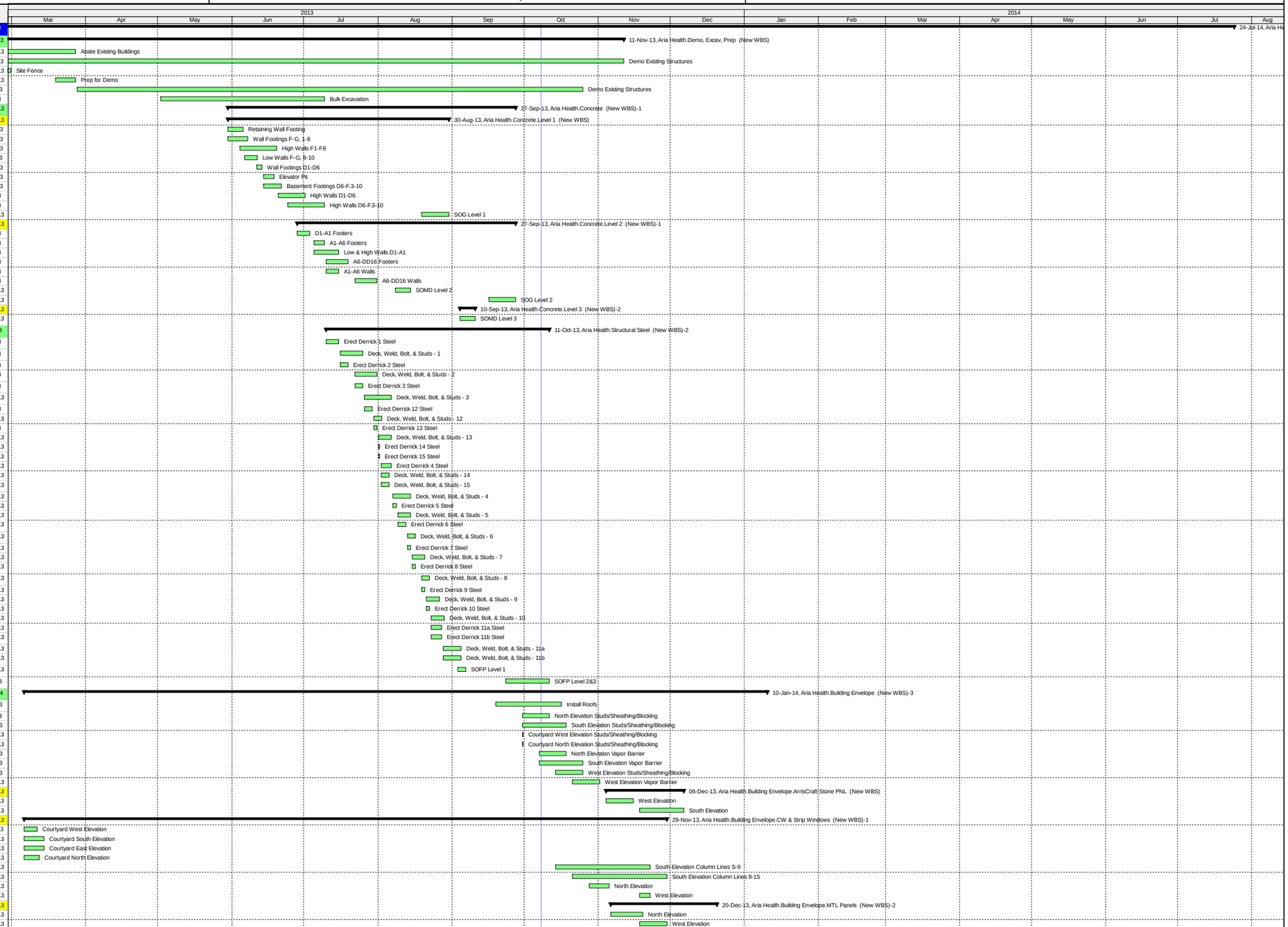
Residential Fixtures, Fittings, and Appliances	Current Baseline
Residential toilets	1.6 (gpf)***
Residential lavatory (bathroom) faucets	2.2 (gpm) at 60 psi
Residential kitchen faucet	
Residential showerheads	2.5 (gpm) at 80 (psi) per shower stall****

Water Use Reduction Table LEED 2009

Appendix A

Project Schedule

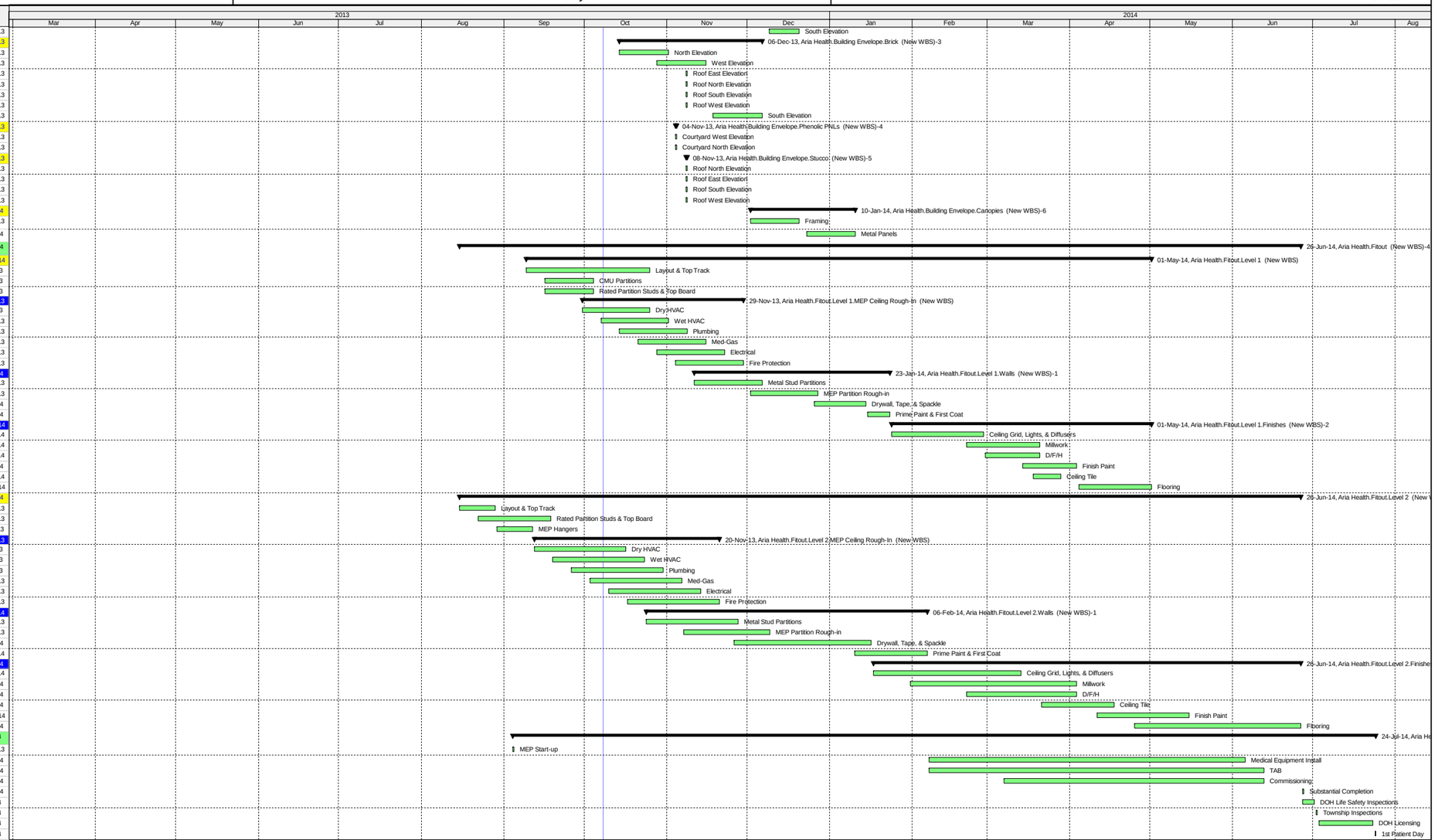
Activity ID	Activity Name	Original Duration	Start	Finish
Aria Health Bob Stano		364	25-Feb-13	24-Jul-14
Aria Health.Demo, Excav, Prep (New WBS)		183	25-Feb-13	11-Nov-13
A1000	Abate Existing Buildings	23	25-Feb-13	27-Mar-13
A1040	Demo Existing Structures	183	25-Feb-13	11-Nov-13
A1030	Site Fence	2	27-Feb-13	28-Feb-13
A1010	Prep for Demo	7	19-Mar-13	27-Mar-13
A1020	Demo Existing Structures	149	28-Mar-13	25-Oct-13
A1050	Bulk Excavation	47	02-May-13	09-Jul-13
Aria Health.Concrete (New WBS)-1		85	30-May-13	27-Sep-13
Aria Health.Concrete.Level 1 (New WBS)		66	30-May-13	30-Aug-13
A1060	Retaining Wall Footing	5	30-May-13	05-Jun-13
A1070	Wall Footings F-G, 1-8	7	30-May-13	07-Jun-13
A1110	High Walls F1-F8	12	04-Jun-13	19-Jun-13
A1100	Low Walls F-G, 8-10	4	06-Jun-13	11-Jun-13
A1080	Wall Footings D1-D6	3	11-Jun-13	13-Jun-13
A1090	Elevator Pit	3	14-Jun-13	18-Jun-13
A1120	Basement Footings D6-F.3-10	6	14-Jun-13	21-Jun-13
A1130	High Walls D1-D6	8	20-Jun-13	01-Jul-13
A1140	High Walls D6-F.3-10	11	24-Jun-13	09-Jul-13
A1150	SOG Level 1	10	19-Aug-13	30-Aug-13
Aria Health.Concrete.Level 2 (New WBS)-1		64	28-Jun-13	27-Sep-13
A1160	D1-A1 Footers	4	28-Jun-13	03-Jul-13
A1170	A1-A6 Footers	3	05-Jul-13	09-Jul-13
A1180	Low & High Walls D1-A1	7	05-Jul-13	15-Jul-13
A1190	A6-DD16 Footers	8	10-Jul-13	19-Jul-13
A1200	A1-A6 Walls	4	10-Jul-13*	15-Jul-13
A1210	A6-DD16 Walls	8	22-Jul-13	31-Jul-13
A1230	SOMD Level 2	5	08-Aug-13	14-Aug-13
A1220	SOG Level 2	10	16-Sep-13	27-Sep-13
Aria Health.Concrete.Level 3 (New WBS)-2		5	04-Sep-13	10-Sep-13
A1240	SOMD Level 3	5	04-Sep-13	10-Sep-13
Aria Health.Structural Steel (New WBS)-2		67	10-Jul-13	11-Oct-13
A1250	Erect Derrick 1 Steel	4	10-Jul-13	15-Jul-13
A1260	Deck, Weld, Bolt, & Studs - 1	8	16-Jul-13	25-Jul-13
A1270	Erect Derrick 2 Steel	4	16-Jul-13	19-Jul-13
A1280	Deck, Weld, Bolt, & Studs - 2	8	22-Jul-13	31-Jul-13
A1290	Erect Derrick 3 Steel	4	22-Jul-13	25-Jul-13
A1300	Deck, Weld, Bolt, & Studs - 3	8	26-Jul-13	06-Aug-13
A1490	Erect Derrick 12 Steel	2	26-Jul-13	29-Jul-13
A1500	Deck, Weld, Bolt, & Studs - 12	4	30-Jul-13	02-Aug-13
A1510	Erect Derrick 13 Steel	2	30-Jul-13	31-Jul-13
A1520	Deck, Weld, Bolt, & Studs - 13	4	01-Aug-13	06-Aug-13
A1530	Erect Derrick 14 Steel	1	01-Aug-13	01-Aug-13
A1550	Erect Derrick 15 Steel	1	01-Aug-13	01-Aug-13
A1310	Erect Derrick 4 Steel	3	02-Aug-13	06-Aug-13
A1540	Deck, Weld, Bolt, & Studs - 14	2	02-Aug-13	05-Aug-13
A1560	Deck, Weld, Bolt, & Studs - 15	2	02-Aug-13	05-Aug-13
A1320	Deck, Weld, Bolt, & Studs - 4	6	07-Aug-13	14-Aug-13
A1330	Erect Derrick 5 Steel	2	07-Aug-13	08-Aug-13
A1340	Deck, Weld, Bolt, & Studs - 5	4	09-Aug-13	14-Aug-13
A1350	Erect Derrick 6 Steel	2	09-Aug-13	12-Aug-13
A1360	Deck, Weld, Bolt, & Studs - 6	4	13-Aug-13	16-Aug-13
A1370	Erect Derrick 7 Steel	2	13-Aug-13	14-Aug-13
A1380	Deck, Weld, Bolt, & Studs - 7	4	15-Aug-13	20-Aug-13
A1390	Erect Derrick 8 Steel	2	15-Aug-13	16-Aug-13
A1400	Deck, Weld, Bolt, & Studs - 8	4	19-Aug-13	22-Aug-13
A1410	Erect Derrick 9 Steel	2	19-Aug-13	20-Aug-13
A1420	Deck, Weld, Bolt, & Studs - 9	4	21-Aug-13	26-Aug-13
A1430	Erect Derrick 10 Steel	2	21-Aug-13	22-Aug-13
A1440	Deck, Weld, Bolt, & Studs - 10	4	23-Aug-13	28-Aug-13
A1450	Erect Derrick 11a Steel	3	23-Aug-13	27-Aug-13
A1470	Erect Derrick 11b Steel	3	23-Aug-13	27-Aug-13
A1460	Deck, Weld, Bolt, & Studs - 11a	5	28-Aug-13	04-Sep-13
A1480	Deck, Weld, Bolt, & Studs - 11b	5	28-Aug-13	04-Sep-13
A1570	SOFP Level 1	4	03-Sep-13	06-Sep-13
A1580	SOFP Level 2&3	15	23-Sep-13	11-Oct-13
Aria Health.Building Envelope (New WBS)-3		218	06-Mar-13	10-Jan-14
A1590	Install Roofs	20	19-Sep-13	16-Oct-13
A1600	North Elevation Studs/Sheathing/Blocking	10	30-Sep-13	11-Oct-13
A1620	South Elevation Studs/Sheathing/Blocking	15	30-Sep-13	18-Oct-13
A1630	Courtyard West Elevation Studs/Sheathing/Blocking	1	30-Sep-13	30-Sep-13
A1640	Courtyard North Elevation Studs/Sheathing/Blocking	1	30-Sep-13	30-Sep-13
A1650	North Elevation Vapor Barrier	10	07-Oct-13	18-Oct-13
A1670	South Elevation Vapor Barrier	15	07-Oct-13	25-Oct-13
A1610	West Elevation Studs/Sheathing/Blocking	10	14-Oct-13*	25-Oct-13
A1660	West Elevation Vapor Barrier	10	21-Oct-13*	01-Nov-13
Aria Health.Building Envelope.ArrisCraft Stone PNL (New WB		24	04-Nov-13	06-Dec-13
A1680	West Elevation	10	04-Nov-13*	15-Nov-13
A1690	South Elevation	14	18-Nov-13*	06-Dec-13
Aria Health.Building Envelope.CW & Strip Windows (New WB		189	06-Mar-13	29-Nov-13
A1740	Courtyard West Elevation	4	06-Mar-13	11-Mar-13
A1750	Courtyard South Elevation	7	06-Mar-13	14-Mar-13
A1760	Courtyard East Elevation	7	06-Mar-13	14-Mar-13
A1770	Courtyard North Elevation	5	06-Mar-13	12-Mar-13
A1720	South Elevation Column Lines S-9	30	14-Oct-13*	22-Nov-13
A1730	South Elevation Column Lines 9-15	29	21-Oct-13*	29-Nov-13
A1700	North Elevation	7	28-Oct-13*	05-Nov-13
A1710	West Elevation	5	18-Nov-13*	22-Nov-13
Aria Health.Building Envelope.MTL Panels (New WBS)-2		32	06-Nov-13	20-Dec-13
A1780	North Elevation	10	06-Nov-13*	19-Nov-13
A1790	West Elevation	9	18-Nov-13*	29-Nov-13



Actual Level of Effort | Remaining Work | Milestone
Actual Work | Critical Remaining Work | summary

TASK filter: All Activities

Activity ID	Activity Name	Original Duration	Start	Finish
A1800	South Elevation	10	09-Dec-13*	20-Dec-13
Aria Health.Building Envelope.Brick (New WBS)-3		39	14-Oct-13	06-Dec-13
A1810	North Elevation	15	14-Oct-13*	01-Nov-13
A1820	West Elevation	15	28-Oct-13*	15-Nov-13
A1840	Roof East Elevation	1	08-Nov-13*	08-Nov-13
A1850	Roof North Elevation	1	08-Nov-13*	08-Nov-13
A1860	Roof South Elevation	1	08-Nov-13*	08-Nov-13
A1870	Roof West Elevation	1	08-Nov-13*	08-Nov-13
A1830	South Elevation	14	18-Nov-13*	06-Dec-13
Aria Health.Building Envelope.Phenolic PNLs (New WBS)-4		1	04-Nov-13	04-Nov-13
A1880	Courtyard West Elevation	1	04-Nov-13*	04-Nov-13
A1890	Courtyard North Elevation	1	04-Nov-13*	04-Nov-13
Aria Health.Building Envelope.Stucco (New WBS)-5		1	08-Nov-13	08-Nov-13
A1900	Roof North Elevation	1	08-Nov-13*	08-Nov-13
A1910	Roof East Elevation	1	08-Nov-13*	08-Nov-13
A1920	Roof South Elevation	1	08-Nov-13*	08-Nov-13
A1930	Roof West Elevation	1	08-Nov-13*	08-Nov-13
Aria Health.Building Envelope.Canopies (New WBS)-6		29	02-Dec-13	10-Jan-14
A1940	Framing	15	02-Dec-13*	20-Dec-13
A1950	Metal Panels	14	23-Dec-13*	10-Jan-14
Aria Health.Fitout (New WBS)-4		223	15-Aug-13	26-Jun-14
Aria Health.Fitout.Level 1 (New WBS)		167	09-Sep-13	01-May-14
A1960	Layout & Top Track	35	09-Sep-13	25-Oct-13
A1970	CMU Partitions	15	16-Sep-13	04-Oct-13
A1980	Rated Partition Studs & Top Board	15	16-Sep-13	04-Oct-13
Aria Health.Fitout.Level 1.MEP Ceiling Rough-In (New WBS)		44	30-Sep-13	29-Nov-13
A1990	Dry HVAC	20	30-Sep-13	25-Oct-13
A2000	Wet HVAC	20	07-Oct-13	01-Nov-13
A2010	Plumbing	20	14-Oct-13*	08-Nov-13
A2020	Med-Gas	20	21-Oct-13*	15-Nov-13
A2030	Electrical	20	28-Oct-13*	22-Nov-13
A2040	Fire Protection	19	04-Nov-13*	29-Nov-13
Aria Health.Fitout.Level 1.Walls (New WBS)-1		52	11-Nov-13	23-Jan-14
A2050	Metal Stud Partitions	19	11-Nov-13*	06-Dec-13
A2060	MEP Partition Rough-in	19	02-Dec-13*	27-Dec-13
A2070	Drywall, Tape, & Spackle	14	26-Dec-13*	14-Jan-14
A2080	Prime Paint & First Coat	7	15-Jan-14*	23-Jan-14
Aria Health.Fitout.Level 1.Finishes (New WBS)-2		70	24-Jan-14	01-May-14
A2090	Ceiling Grid, Lights, & Diffusers	25	24-Jan-14*	27-Feb-14
A2100	Millwork	20	21-Feb-14*	20-Mar-14
A2120	D/F/H	15	28-Feb-14*	20-Mar-14
A2130	Finish Paint	15	14-Mar-14*	03-Apr-14
A2110	Ceiling Tile	9	18-Mar-14*	28-Mar-14
A2140	Flooring	20	04-Apr-14*	01-May-14
Aria Health.Fitout.Level 2 (New WBS)-1		223	15-Aug-13	26-Jun-14
A2150	Layout & Top Track	10	15-Aug-13	28-Aug-13
A2160	Rated Partition Studs & Top Board	19	22-Aug-13	18-Sep-13
A2170	MEP Hangers	9	29-Aug-13	11-Sep-13
Aria Health.Fitout.Level 2.MEP Ceiling Rough-In (New WBS)		50	12-Sep-13	20-Nov-13
A2180	Dry HVAC	25	12-Sep-13	16-Oct-13
A2190	Wet HVAC	25	19-Sep-13	23-Oct-13
A2200	Plumbing	25	26-Sep-13	30-Oct-13
A2210	Med-Gas	25	03-Oct-13	06-Nov-13
A2220	Electrical	25	10-Oct-13*	13-Nov-13
A2230	Fire Protection	25	17-Oct-13*	20-Nov-13
Aria Health.Fitout.Level 2.Walls (New WBS)-1		74	24-Oct-13	06-Feb-14
A2240	Metal Stud Partitions	25	24-Oct-13*	27-Nov-13
A2250	MEP Partition Rough-in	22	07-Nov-13*	09-Dec-13
A2260	Drywall, Tape, & Spackle	36	26-Nov-13*	16-Jan-14
A2270	Prime Paint & First Coat	20	10-Jan-14*	06-Feb-14
Aria Health.Fitout.Level 2.Finishes (New WBS)-2		115	17-Jan-14	26-Jun-14
A2280	Ceiling Grid, Lights, & Diffusers	40	17-Jan-14*	13-Mar-14
A2290	Millwork	45	31-Jan-14*	03-Apr-14
A2310	D/F/H	30	21-Feb-14*	03-Apr-14
A2300	Ceiling Tile	20	21-Mar-14*	17-Apr-14
A2320	Finish Paint	25	11-Apr-14*	15-May-14
A2330	Flooring	45	25-Apr-14*	26-Jun-14
Aria Health.Closeout (New WBS)-5		230	04-Sep-13	24-Jul-14
A2340	MEP Start-up	1	04-Sep-13	04-Sep-13
A2360	Medical Equipment Install	85	07-Feb-14*	05-Jun-14
A2370	TAB	90	07-Feb-14*	12-Jun-14
A2380	Commissioning	70	07-Mar-14*	12-Jun-14
A2350	Substantial Completion	1	27-Jun-14*	27-Jun-14
A2390	DOH Life Safety Inspections	3	27-Jun-14*	01-Jul-14
A2400	Township Inspections	1	02-Jul-14*	02-Jul-14
A2410	DOH Licensing	15	03-Jul-14*	23-Jul-14
A2420	1st Patient Day	1	24-Jul-14*	24-Jul-14



Actual Level of Effort | Remaining Work | Milestone
Actual Work | Critical Remaining Work | summary

TASK filter: All Activities

Appendix B

Mechanical System Influence Areas

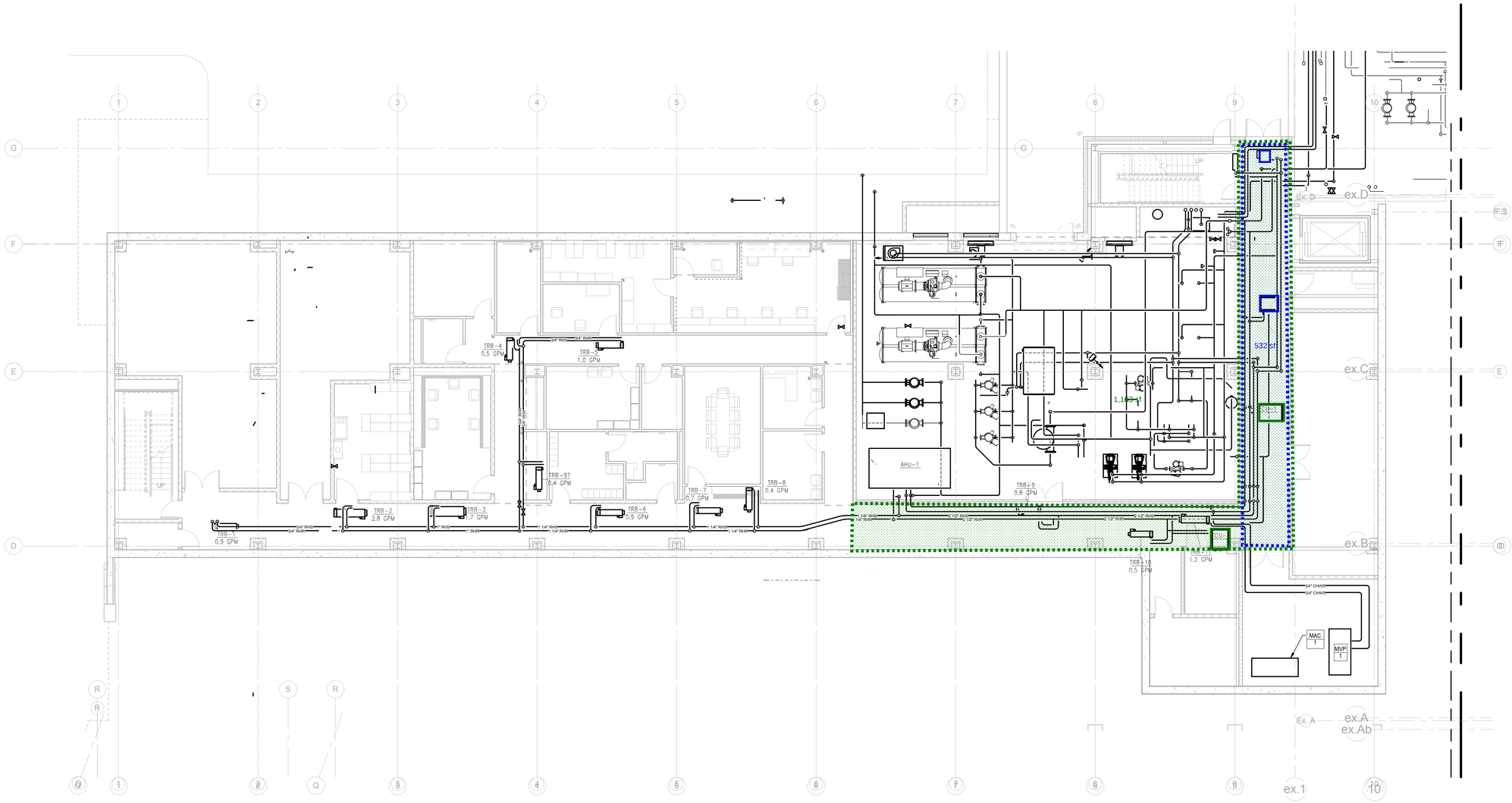
Blue – Unit Heaters

Red – Perimeter Radiation

Green – Fan Coil Units

Unclassified – AHU/Boiler/CH/CT

Mechanical Influence Areas

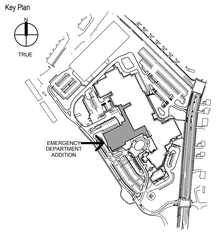


1 H-301 LEVEL 1 HVAC-PIPING
1/8" = 1'-0"

Revisions

No.	Description	Date

Key Plan



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Date
10/26/12

Drawn By
Author

Scale
AS NOTED

Seal

Checker

Francis Cauffman

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Project Number
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Drawing Title and Number
LEVEL 1 HVAC - PIPING

H-301

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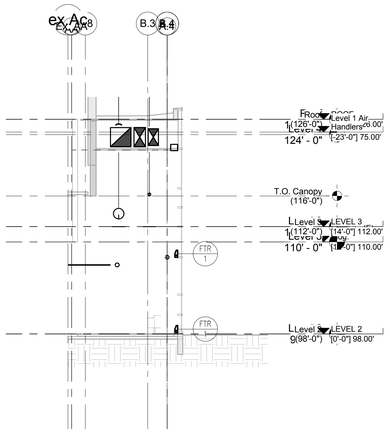
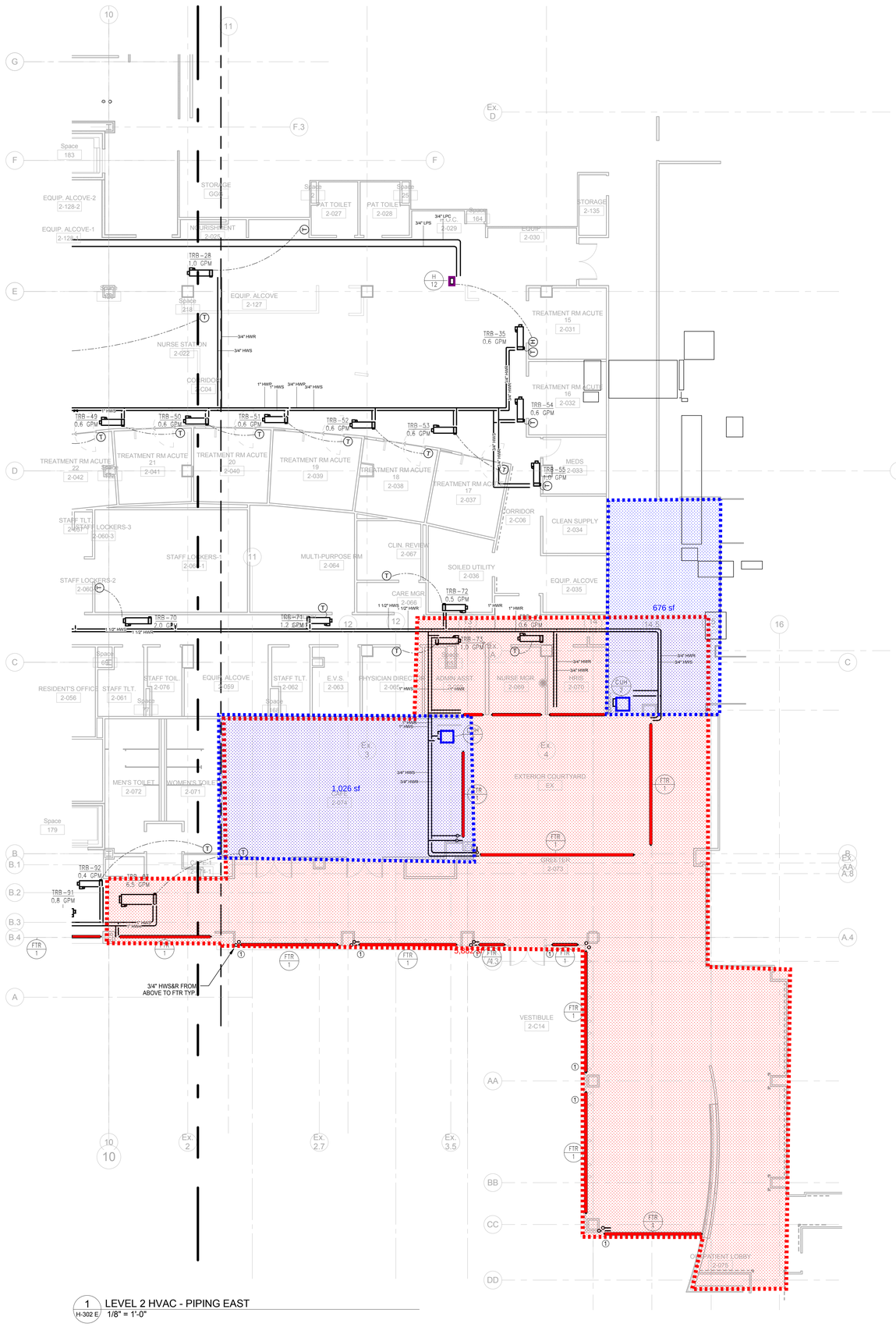


2 FTR VIEW
H-302 E 1/8" = 1'-0"

PIPING NOTES:
1. FLOOR MOUNTED FTR AND SHADOW BOX MOUNTED FTR SEE DETAIL HX.XX/XX

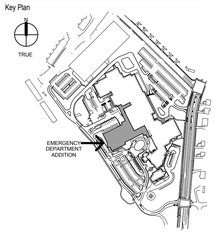


1 LEVEL 2 HVAC - PIPING EAST
H-302 E 1/8" = 1'-0"

Revisions

No.	Description	Date

Key Plan



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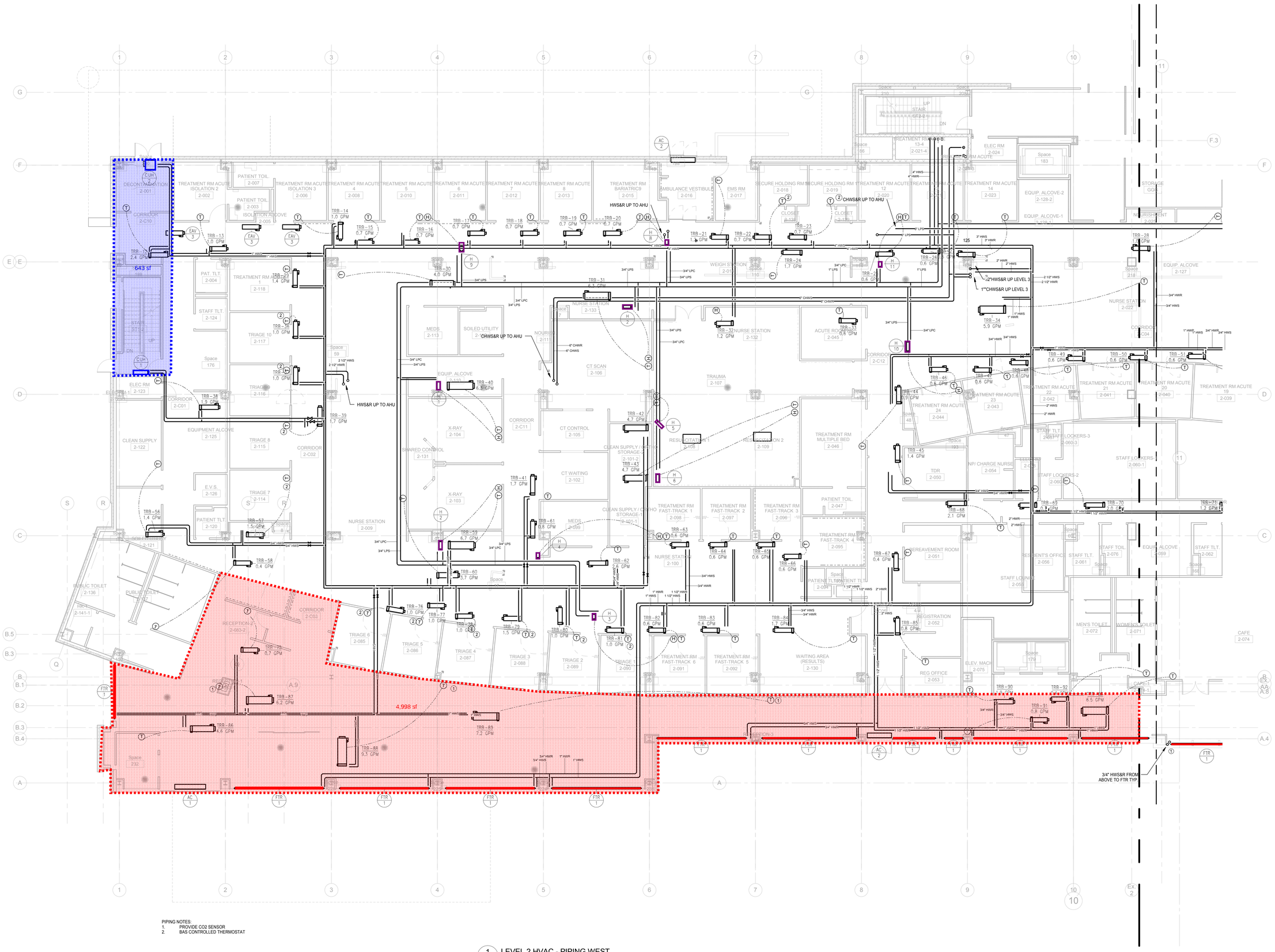

PIPING NOTES:
1. PROVIDE CO2 SENSOR
2. BAS CONTROLLED THERMOSTAT

1 / H-302 W — LEVEL 2 HVAC - PIPING WEST
1/8" = 1'-0"

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Revisions

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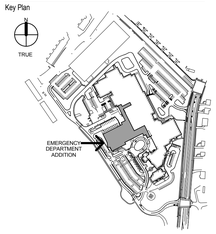

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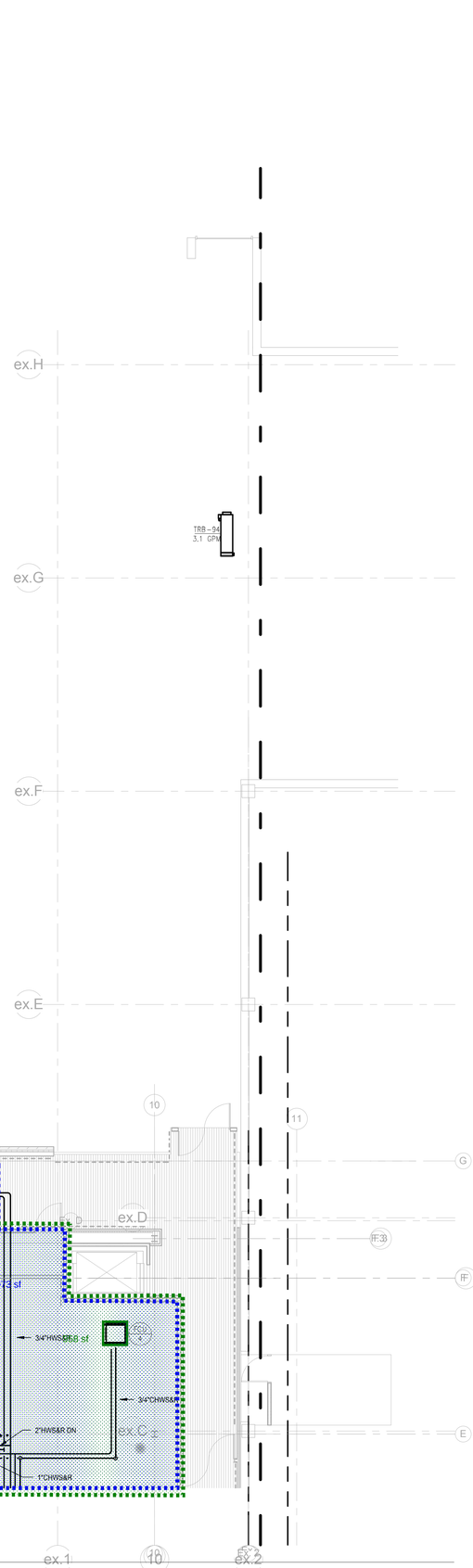
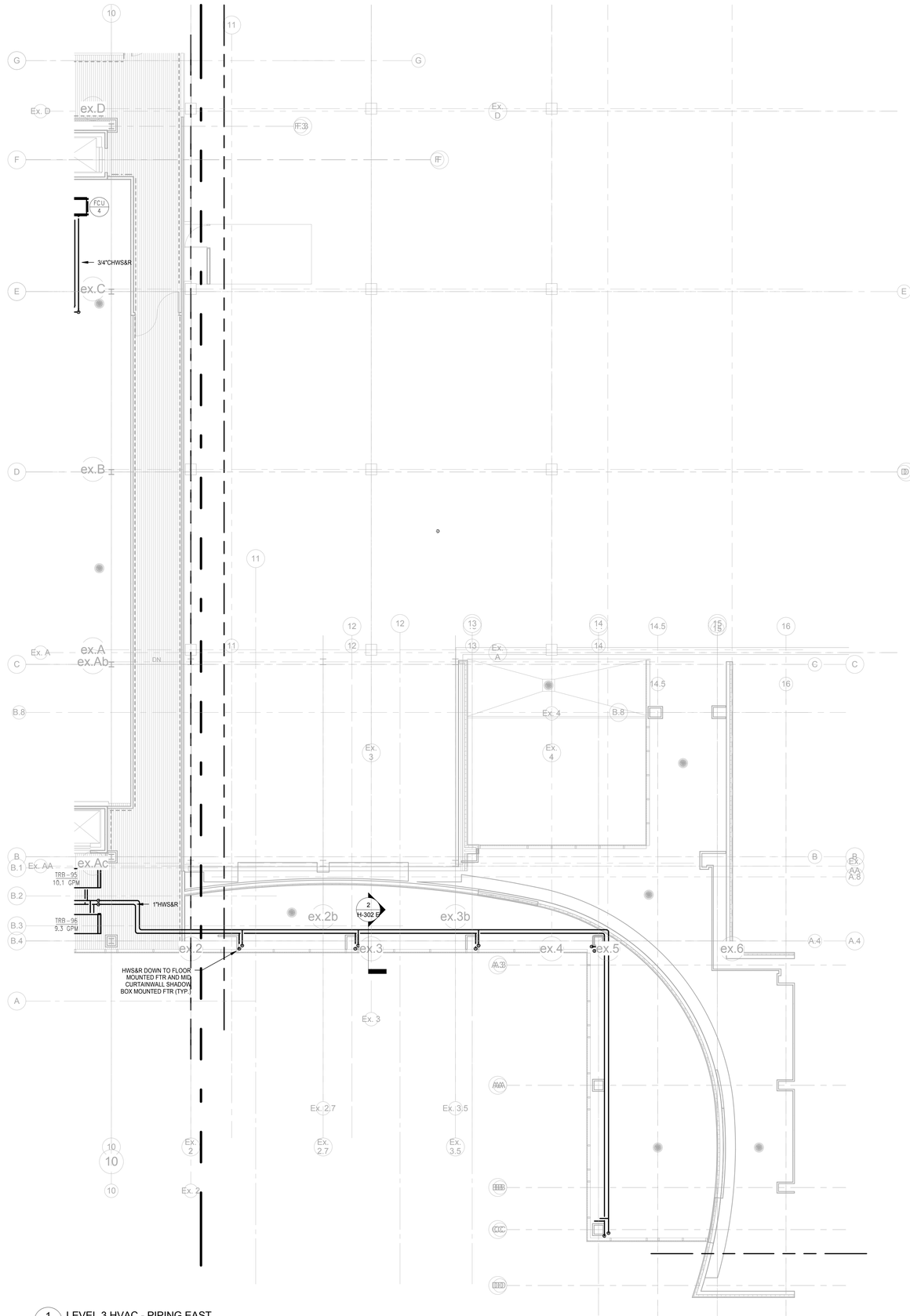
H-302 W



2 LEVEL 3 HVAC - PIPING LAB LINK
H-303 E 1/8" = 1'-0"

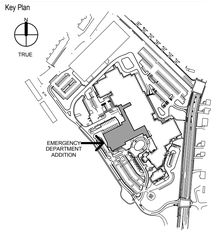


1 LEVEL 3 HVAC - PIPING EAST
H-303 E 1/8" = 1'-0"

Revisions

No.	Description	Date

Key Plan



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H-303 E

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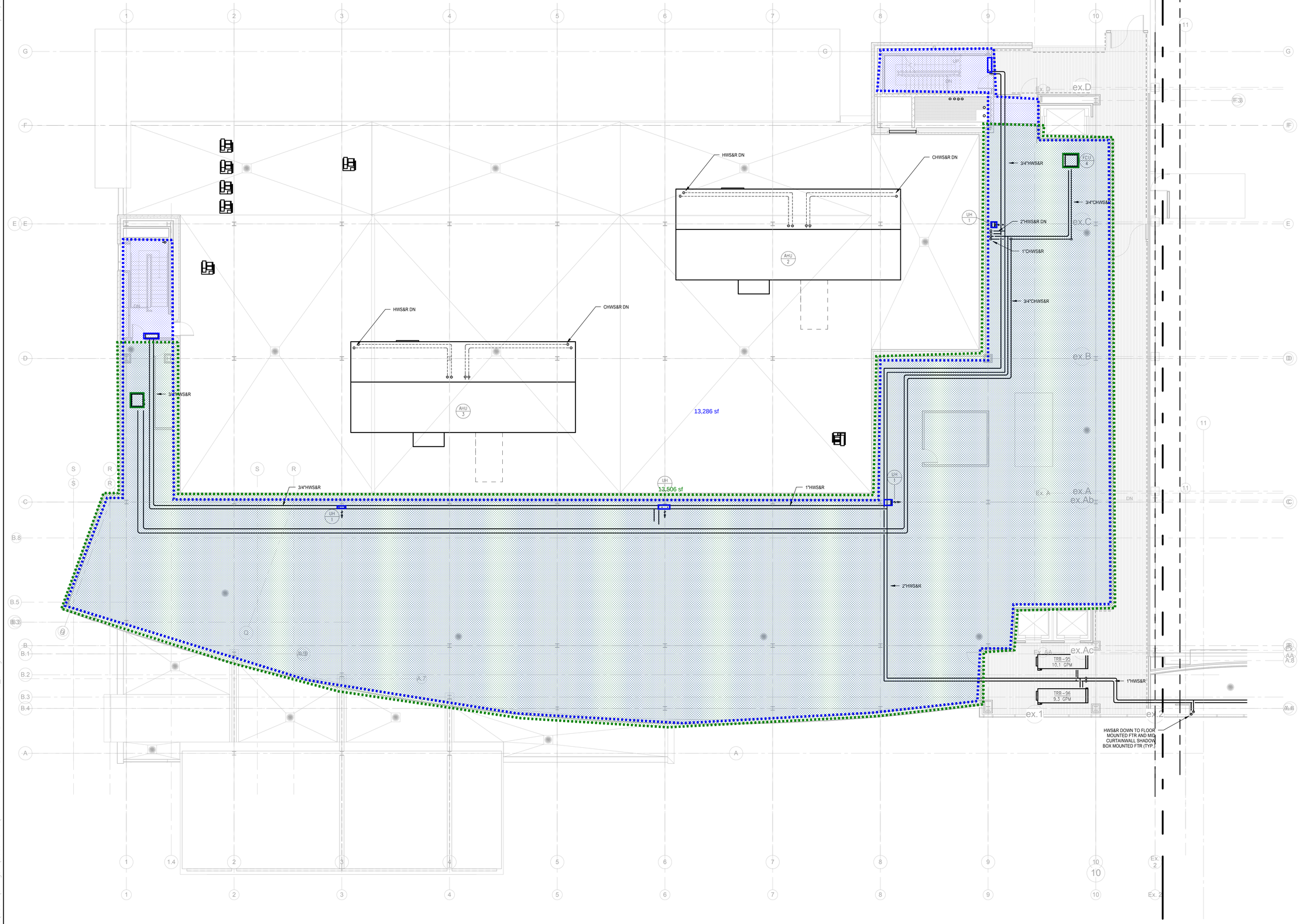

1 LEVEL 3 HVAC - PIPING WEST
H-303 W 1/8" = 1'-0"

Revisions

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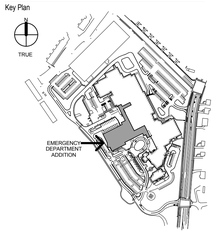

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H-303 W

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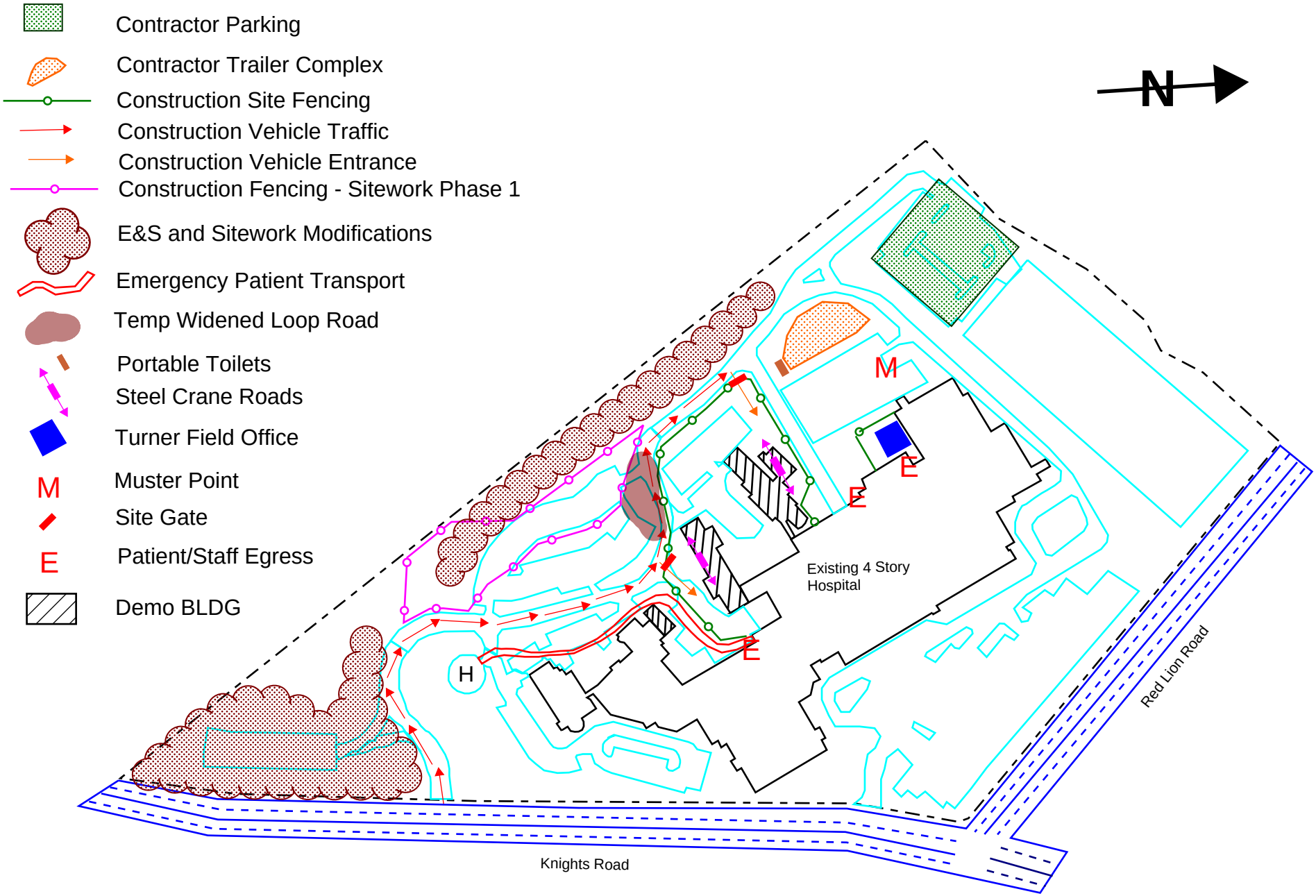
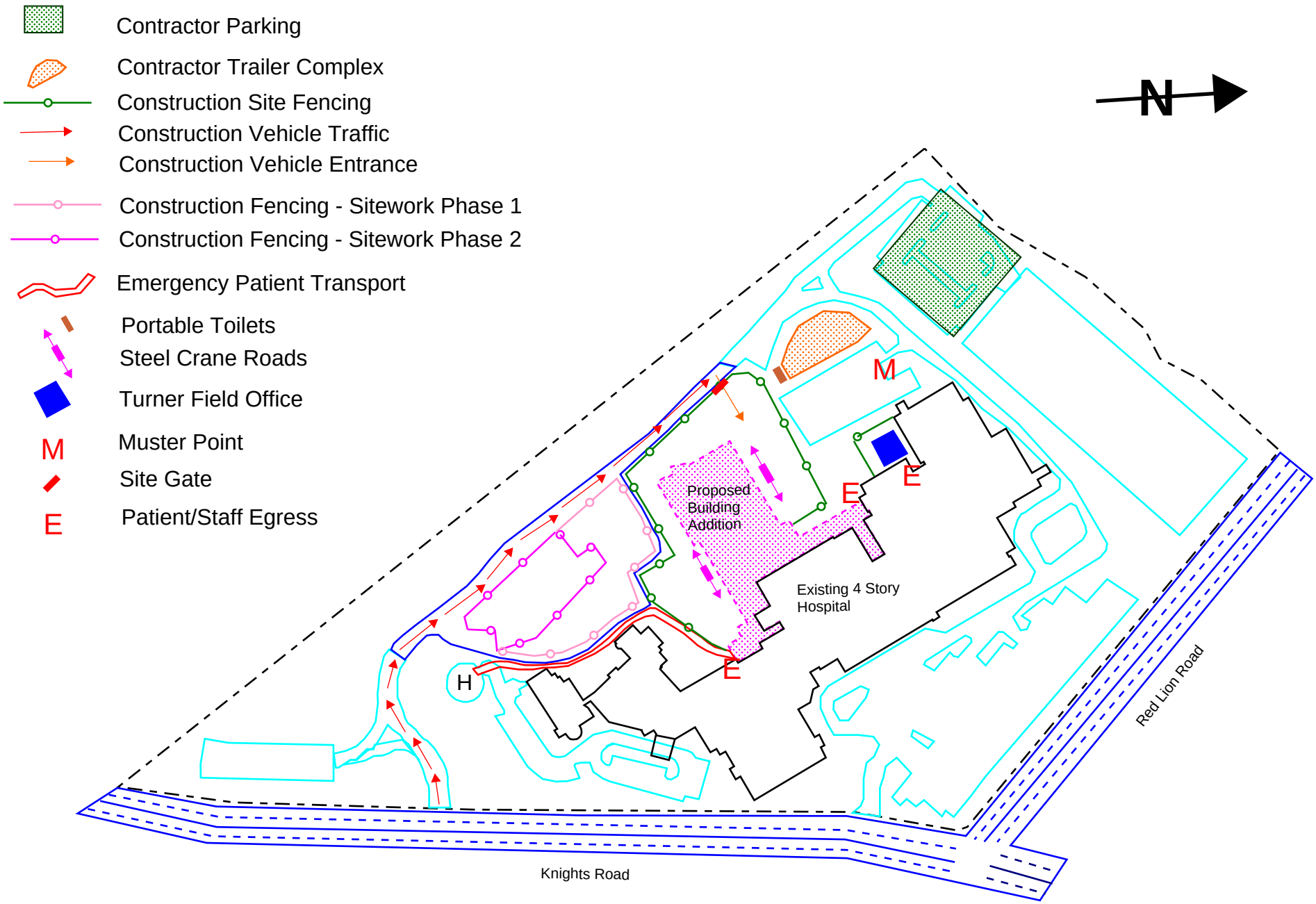
Appendix C

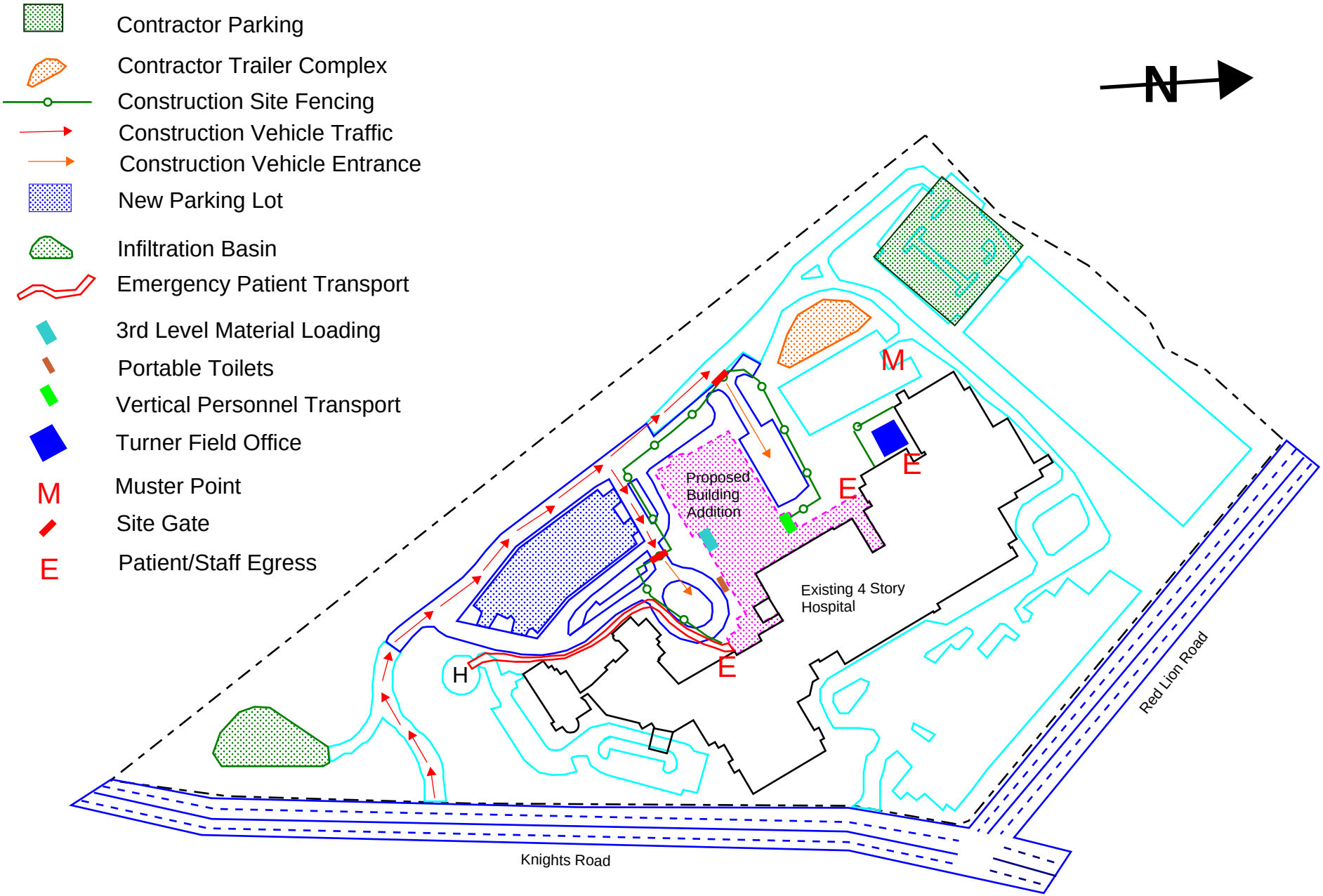
Site Logistics Plans



Existing Structure Demolition



Foundation and Structure



Rough-In and Interiors Phase