Fort Pickett Regional Training Institute Phase II
Blackstone, VA

Technical Assignment 1

Figure 1: Site Aerial - Courtesy of Barton Malow

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Executive Summary

On February 27, 2010, the Virginia Army National Guard contracted Barton Malow to construct and design three billeting buildings totaling 116,400 SF at the Fort Pickett Regional Training Institute in Blackstone, VA. The $28M contract was awarded as an option upon successful completion of Phase I of the Regional Training Institute. The three barracks buildings are being constructed in order to replace the debilitated and potentially dangerous housing constructed during the World War II era. The project was bid as a Design-Build delivery system, making integration between Barton Malow's design and construction teams critical for success. Although Department of Defense buildings are represented and managed under strict guidelines, the Barton Malow project team has excelled in regards to the project schedule, budget, and site logistics.

After a thorough analysis of the project's cost overview, it was found that the construction costs associated with the actual construction of the buildings were significantly higher than estimates conducted using assembly and square foot methods. The actual cost of construction was $23.7M at $204/SF, where the square foot and assemblies estimate resulted in values of $14.5M at $125/SF. Reasons for this discrepancy can be partially contributed to the lack of mechanical equipment accounted for in the estimate, as well as the neglecting of blast proof components of the buildings. The project summary schedule displayed an atypical layout in comparison to traditional delivery methods with the design phase and procurement phase overlapping part of the construction work. Since the billeting buildings are Phase II of the original project, 30% design documents were created for the original contract, but after being awarded Phase II, a design needed to be finalized for construction. The large magnitude of the job site also contributed to the success of the project, eliminating any problems with space, deliveries, and transportation. Areas were designated at the initial stage of the project and were able to remain consistent throughout the life of the project, which eliminated wasteful relocation of resources. Possibly the largest contributor towards the success of the project was the staff involved with the project. At the peak of construction, the Barton Malow project team consisted of seven members; five of the members were returning from Phase I. In addition, Phase I served as a trial run, in regards to meeting the client's expectations, which allowed Phase II to excel.

The billeting buildings serve as an example of premiere construction planning and implementation. Although the cost of construction seems to be fairly high in comparison to conducted estimates, all other aspects related to the construction process were performed with little to criticize. The combination of proper budgeting, efficient sequencing, convenient job site planning, more than adequate staffing, and past experience with the Owner from Phase I have created a successful construction implementation.

Table of Contents

Project Schedule Summary

Upon successful completion of Phase I, the Virginia Army National Guard (VAARNG) decided to award Barton Malow Phase II of the project, giving them notice to proceed on February 27, 2010. Due to the unique situation with a phased Design-Build delivery system with an option for the second phase, the project schedule is very different than a traditional schedule. A project summary schedule can be seen in Appendix A, which is broken into four key phases: Design, Procurement, Construction, and Commissioning/Closeout.

Since the project was hard bid to include both phases with an option to proceed with Phase II, an initial design needed to be created to appropriately bid the project. The project was bid using 30% design documents, which means that at the notice to proceed with Phase II, the design needed to be finalized to reach 100% design documents. It can also be noted that most of the site MEP work was performed in Phase I, which allowed Barton Malow to expedite the site work. Although the schedule summary does not reflect the work prior to being awarded Phase II and the demolition that will follow the construction of the billeting building, these items will be addressed and documented in the detailed schedule in Technical Report 2. Within the Design Phase, Barton Malow obtained payment and performance insurance, conducted geotechnical reports, calculated building estimates, and created/issued design drawings for the VAARNG to approve for construction. The Procurement Phase consisted of establishing a schedule with the Army Corps of Engineers (COE), as well as the handling of contracts and submittals with Subcontractors. The duration of this phase stretched into the later portion of the project, since the procurement steps extend as far as the fabrication and delivery of the materials to the site.

The Construction Phase involved a phased construction sequence between the three billeting buildings, Buildings 500, 600, and 700. Due to the unique layout of the campus, the three billeting buildings were constructed in a phased approach consisting of six areas. The lead floor was the ground floor of Building 700, followed by the ground floor of Building 500, and so on, until it reached the second floor of Building 600. The lag maintained an approximate one week separation on the schedule, in order to fluidly move workers from one building to the next. This was believed to be an ideal strategy to eliminate any potential hindrance from an often-detrimental learning curve. Contrary to an obvious strategy of moving from building to building based on the next building in line, the first two buildings to begin work were the identical buildings across the campus from one another, so that the learning curve could be further minimized. To see this flow of work, refer to Appendix C-2. The following activities show a further look into the sequencing:

Foundation

Upon proper excavation and installation of site utilities, the foundations were ready to begin work. They primarily consisted of continuous footings with a few spread footings located at structural column areas. The process consisted of excavation, reinforcing, pouring, and backfill on the project schedule. In addition to constructing the foundations, the phased construction allowed for work to begin on the slab on grade in some areas.

Structural

The structural work was made-up of a number of scheduled activities, which strongly resemble residential construction sequencing. The work began with the installation of structural steel and cold formed metal studs that serve as load bearing walls. Shear walls were then constructed by fastening diagonal steel straps across designed bearing walls. From there, hollow-core planks were placed on top of the first level of bearing walls and then topped with 2” of concrete. Once the hollow-core planks were secured, the next level of bearing walls were constructed and then finally topped with trusses and structurally insulated panels on the roof. Within the structural activities, cranes were mobilized to place the hollow core planks and roof trusses.

Finishes

The finishes sequence began with the application of the first coat of paint on the walls, but also included casework, ceramic tile, acoustical ceiling tile, resilient flooring, carpeting, trim work, window sills, toilet partitions, toilet accessories, and finish paint coats. Although the items were grouped into one activity on the project summary schedule, the items will go into further detail in the upcoming detailed schedule in Technical Report 2. In addition to the installation of finishes, this sequence also included punch list and commissioning activities conducted by the Barton Malow project team. This sequencing approach made it easy to transition into the Commissioning/Closeout Phase. The project’s final completion is expected to be reached on January 13, 2012.

Building Systems Summary

Yes	No	Work Scope
X		Demolition Required
X		Structural Steel Frame
X		Cast in Place Concrete
X		Precast Concrete
X		Mechanical System
X		Electrical System
X		Masonry
	X	Curtain Wall
	X	Support of Excavation

Table 1: Building Systems Checklist – Developed by Kendall Mahan

Demolition

In accordance to the project contract, Barton Malow is to demolish a number of buildings that are later to be specified. In order to meet restrictions attached to the project funding, a specified amount of occupiable square footage is to be demolished in equivalence to the square footage being constructed. The buildings that are in discussion for demolition were constructed during the World War II era and are no longer suitable for occupancy. The buildings are composed of hazardous materials, such as lead paint and asbestos insulation. Although the buildings are not on the site of the Regional Training Institute, the buildings are to be demolished following the construction of the billeting buildings.

Structural Steel Frame

The project consists of three, two level stand-alone structures. The structural steel frame differed from traditional methods, primarily using cold formed steel metal studs to support the buildings, similar to dormitories or residential construction. The cold formed steel bearing walls consisted of 14 and 16 gage studs placed at 16” on center, which can be seen in Fig. 2 to the right. Unlike traditional steel

Figure 2: Metal Stud Bearing Walls - Courtesy of Barton Malow

structures, metal decking was not used for the floor support system, and instead hollow-core planks were used. The planks rested on the cold formed steel metal stud wall panels, as well as W12x26 structural steel wide flange beams that served as headers across the large doorway openings. The roofs for all buildings are supported by pre-engineered cold formed steel roof trusses, which are supported on cold formed bearing wall panels and W10 x22 structural steel wide flange beams. The roof trusses, as well as a few structural members that served as headers were the only part of the steel structure that required the use of a crane throughout the course of the project. In order to lift these items, two cranes were utilized, including a 75 ton and 100 ton crawler crane. In addition, a cold-formed steel load bearing shear wall system is used to resist wind and earthquake loads, directing lateral forces from the roof level, through the rigid level floor supports, and into the foundations. The exterior wall enclosure is composed of cold formed steel framing, serving as a back-up to a split-faced CMU veneer and other wall finish materials.

Cast in Place Concrete

Figure 3: Slab on Grade - Courtesy of Barton Malow

Cast-in-place concrete was used on a number of different aspects of the buildings, specifically the foundations and the floor topping slabs. All of the buildings are supported on continuous footings and spread footings at column locations bearing on native soil. In addition, all of the buildings have a 4" minimum slab on grade that is reinforced with welded wire fabric/fiber mesh over a vapor barrier bearing on 4" of compact granular fill. As mentioned previously, precast hollow core planks served as the structural floor, but the planks were topped with 2" of cast in place concrete to eliminate the plank joints, as well as give the floor greater structural integrity. All of the concrete poured on site was placed using a pump truck, which can be seen above in Fig. 3. Wooden formwork was used for the slab on grade and topping slab pours.

Precast Concrete

The supported floors for all buildings consist of 8" thick precast hollow-core plank. The hollow-core planks were connected together by sliding the ends together, reinforcing the joint, grouting the joint, and then placing a 2" concrete topping slab on top that was reinforced with welded wire fabric. The hollow-core planks are supported on cold formed steel bearing wall panels, which can be seen in Fig. 4 to the right. The hollow-core planks were placed using the 75 ton and 100 ton crawler cranes that were also used for the trusses. In order to expedite the setting process, the cranes were located on opposite sides of the buildings and then alternated lifts along the length of the building.

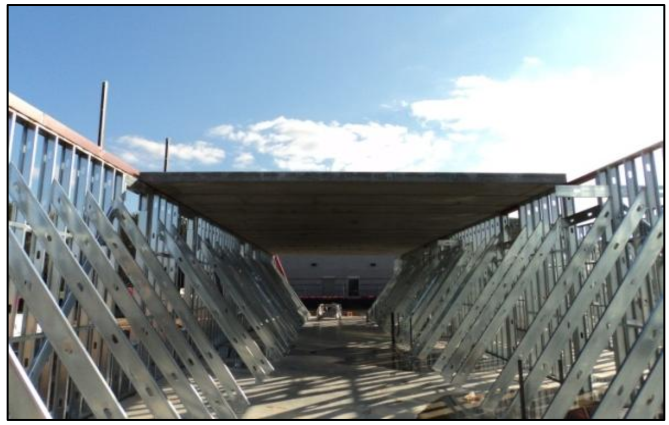


Figure 4: Hollow-Core Planks - Courtesy of Barton Malow

Mechanical System

Figure 5: Heat Pump - Photo Taken by Kendall Mahan

The mechanical system is composed of a central closed water loop heat pump system, which is incorporated into the rest of the campus. To handle the additional load, a 240 KW electrical boiler, associated pumps, and a 200 ton closed cell fluid cooler were added to the mechanical room of a neighboring building. Underground HDPE piping routes the ethylene glycol fluid to the campus, where each building will be provided with base mounted VFD pumps. One of the pumps will be on 100% standby at all times, but will be coordinated by a lead/lag cycle to equalize wear. The pumps are controlled through VFD's to maintain a preset pressure differential across the piping system and will reduce flow at times when building occupancies are low to save energy. The corridor ceiling space is occupied by high efficiency horizontally placed heat pumps. The heat pumps are supplied with environmentally friendly refrigerant R 410a. The fans are driven by high efficiency ECM motors. The compressors are two stage to match the capacity to the load. They have supply and return ductwork with outdoor ventilation air ducted directly to the return air side. The heat pumps are provided with two way control valves to work in conjunction with the VFD pumps to reduce energy using during part load conditions. In general, three to five rooms will be supplied from one heat pump, which reduces maintenance work load, allows for closer match between actual heating/cooling load and heat pump capacity, and greatly reduces congestion in the ceiling plenum. Energy recovery ventilators are used to pre-treat outdoor air with toilet room exhaust through an enthalpy heat wheel, which allows negligible amounts of air crossover. This saves substantial energy and reduces the design heating and cooling loads.

Electrical System

The primary electrical distribution is supplied by the Southside Electrical Utility, where primary power will run to transformers located on pads 33 ft. behind each building. The transformers feeding the service are 5000KVA. The electrical rooms are accessible from the exterior of each building and feature an 800A switchboard at 277/480V/3PH/4W that services a 277/480V lighting panel, and power distribution panels for mechanical loads located in the first and second floor electrical rooms. The electrical rooms have transformers serving 120/208V panel boards servicing the receptacles, washers, dryers, 208V heat pumps, and all 120V mechanical equipment throughout the buildings. In order to become more environmentally friendly, occupancy sensors were placed in every room to minimize the amount of energy wasted in typical buildings.

Masonry

A rusticated masonry exterior skin was integrated using a variety of masonry units. The various colors meet the requirements identified by the Virginia National Guard. Multiple textures accented by detailed banding in the masonry are used to reinforce human scale and add a visual aesthetic to the facility. Vertical elements were implemented to break ups its linear nature, moreover drawing attention to the entrances and reinforcing the overall axial plan of the campus. The façade is composed of a variety of CMU textures and colors, including split-faced and smooth block, which can be seen in Fig. 6. The 8” CMU block is supported by the structural steel bearing walls around the exterior of the building. Ledges are strategically located to distribute the load accordingly amongst the structural members. Hydraulic scaffolding was utilized throughout the masonry construction process to expedite the placing of block.

Figure 6: CMU Facade-Taken by Kendall Mahan

Project Cost Summary

In order to get a better understanding of the costs associated with the buildings, it was critical to conduct a number of cost analyses, including a cost overview, systems overview, square foot estimate, and assemblies estimate. The project cost overview can be seen below in Table 2, which includes a number of different figures. Since Phase II consists of both the construction of the billeting buildings and demolition, there are two different line items with general conditions included and not included for both. These construction costs also include the 3% contractor's fee, but do not take into account contingency, insurance, etc. The last line item shows the total project cost or the GMP cost. Each line item also includes a cost per square foot cost value.

Project Cost Overview (116,400 SF)		
	Actual Cost	**Cost/SF**
Construction Cost (Billeting Buildings)		
Actual (Without General Conditions)	$22,031,725.00	$189.28
Actual (With General Conditions)	$23,750,812.28	$204.04
Construction Cost (Billeting Buildings & Demolition)		
Actual (Without General Conditions)	$22,789,225.00	$195.78
Actual (With General Conditions)	$24,724,716.44	$212.41
Total Project Cost		
Actual GMP Cost	$28,177,099.98	$242.07

Table 2: Project Cost Overview – Developed by Kendall Mahan

The next cost analysis conducted was the building systems overview, which can be observed in Table 3 on the following page. The table breaks down the actual cost, cost per square foot, and percentage of building cost associated with all of the major building systems. Due to the high energy efficiency associated with the mechanical system, the initial cost was elevated, but it is believed to be in the best interest of the Owner in regards to the life cycle cost of the building. The mechanical/plumbing systems comprised nearly 20% of the total building cost. Another staggering figure was the drywall/metal framing line item, which made-up over 11% of the building cost. Although this is a significant percentage of the building cost, the metal studs served as load bearing walls, so the elevated percentage was expected.

Building Systems Overview			
	Actual Cost	**Cost/SF**	**% of Building Cost**
Acoustical Ceilings	$381,202.00	$3.27	16.1
Concrete Cast-in-Place	$1,243,212.00	$10.68	5.2
Demolition	$757,500.00	$6.51	3.2
Drywall/Metal Framing	$2,634,376.00	$22.63	11.1
Electrical	$2,808,994.00	$24.13	11.8
Fire Protection	$359,055.00	$3.08	1.5
Masonry	$249,066.00	$2.14	1.0
Mechanical/Plumbing	$4,689,430.00	$40.29	19.7
Painting	$264,155.00	$2.27	1.1
Precast Concrete	$657,224.00	$5.65	2.8
Resilient Flooring	$613,504.00	$5.27	2.6
Roof Deck/SIPS Panels	$762,424.00	$6.55	3.2
Roofing	$1,705,486.00	$14.65	7.2
Sitework	$1,522,575.00	$9.15	6.4
Structural Steel Framing	$944,350.00	$8.11	4.0

Table 3: Building Systems Overview – Developed by Kendall Mahan

The next estimate performed was a square foot estimate using RSMeans CostWorks, which can be seen in Appendix B-1 and B-2. Two estimates were conducted in order to account for the three buildings; Appendix B-1 accounts for the identical buildings, Buildings 500 and 700, and Appendix B-2 accounts for Building 600. Shown on the following page in Table 4, the results of the estimate are calculated for each of the three billeting buildings. The buildings were adjusted for a number of different factors, including location, non-union work, area, perimeter, stories, floor height, and construction type. Using these adjustments provided the most accurate estimate as possible. Since Military barracks were not an option within the building type category, college dormitories were selected, since they were believed to be the most similar. Both building types feature a floor layout primarily composed of shared bedrooms and bathrooms, which is a more appropriate comparison than apartments that are designed with kitchens.

RSMeans CostWorks Square Foot Cost Estimate			
Building #	500	600	700
Building Type	College Dormitory (2-3 Story)		
Construction Type	Decorative Concrete Block with Steel Frame		
Location	Petersburg, VA		
Date	Year 2011 Quarter 3		
Labor Type	Open Shop/Non-Union		
Story Height (LF)	11.83		
Stories Count		2	
Area (SF)	40,428	35,544	40,428
Perimeter (LF)	858	766	858
Total Building Cost	$4,838,500	$4,279,500	$4,838,500
Total Building Cost	**$13,956,500**		
SF Cost	$119.68	$120.40	$119.68
SF Cost	**$119.90**		

Table 4: RS Means Square Foot Cost Estimate – Developed by Kendall Mahan

The last estimate performed for comparison was a MEP assemblies' estimate, which can be found in Appendix B-3. The estimate took a more in depth analysis of the MEP systems using systems accurate to those of the systems used on the actual buildings, which created a much more accurate estimate when the values of the systems were plugged into the square foot estimate. Table 5, found on the following page, displays the MEP costs, costs per square foot, and percentage of building costs for the three cost analysis methods. The assemblies estimate for the electrical work nearly matched the actual cost of the electrical system. Fire protection became much more accurate, missing the actual amount by only 0.2%. The last system and the most varying from the actual cost of construction was the mechanical/plumbing. The difference between the assemblies cost and the actual cost was 7.5%, a significant difference. Reasoning behind this difference could be due to a number of different reasons, specifically the exclusion of mechanical equipment. The billeting buildings were designed with ERVs, VFDs, and glycol pumps to control the desired temperatures for the heat pumps, which were all neglected from the estimate, since the items could not be found within CostWorks. The assemblies estimate lacked options to include these pieces of equipment, which contributed to part of the disparity between values.

Actual Construction Cost			
	Total Cost	**Cost/SF**	**% of Building Cost**
Electrical	$2,808,994.00	$24.13	11.8
Fire Protection	$359,055.00	$3.08	1.5
Mechanical/Plumbing	$4,689,430.00	$40.29	19.7
RSMeans CostWorks SF Estimate			
	Total Cost	**Cost/SF**	**% of Building Cost**
Electrical	$ 1,592,000.00	$ 13.68	6.7
Fire Protection	$ 286,000.00	$ 2.46	1.2
Mechanical	$ 1,029,000.00	$ 8.84	4.3
Plumbing	$ 2,089,500.00	$ 17.95	8.8
RSMeans CostWorks Assemblies Estimate			
	Total Cost	**Cost/SF**	**% of Building Cost**
Electrical	$ 2,386,416.24	$ 20.50	10.1
Fire Protection	$ 304,467.23	$ 2.62	1.3
Mechanical	$ 1,873,814.63	$ 16.10	7.9
Plumbing	$ 1,015,596.30	$ 8.73	4.3

Table 5: System Cost Comparisons – Developed by Kendall Mahan

After conducting estimates using a variety of methods, it was then possible to gain a better understanding of the costs associated with construction. Table 6 below shows these cost comparisons and reveals a finer gap between the actual construction cost and the square foot cost when the assemblies' revisions were factored in. The total costs differ by $9.2M, but these inaccuracies are believed to be contributed to some of the special construction requirements, such as special blast proof windows, doors, and end-walls. The use of hollow-core planks, though faster to erect, cost a significant more than typical metal decking and cast in place concrete floor system. The combination of these items, as well as the missing mechanical equipment mentioned earlier is believed to be a fair assessment for the discrepancy found between values.

Construction Cost Comparisons		
	Total Cost	**Cost/SF**
Actual Construction Cost	$ 23,750,812.28	$ 204.04
SF Estimate Cost	$ 13,956,500.00	$ 119.90
SF Estimate Cost/ MEP Assemblies Estimate	$ 14,540,294.40	$ 124.92

Table 6: Construction Cost Comparisons – Developed by Kendall Mahan

Existing Conditions

The Fort Pickett Regional Training Institute is located just outside of Blackstone, VA and around 60 miles southwest of Richmond, VA, which can be seen in Fig. 7 to the right. The military base is located on swampy land, which was previously deemed as unsuitable for construction, but viewed as ideal training grounds for the Virginia Army National Guard and other Federal agencies. The site of the project was once a forested area, but has now been cleared for construction.

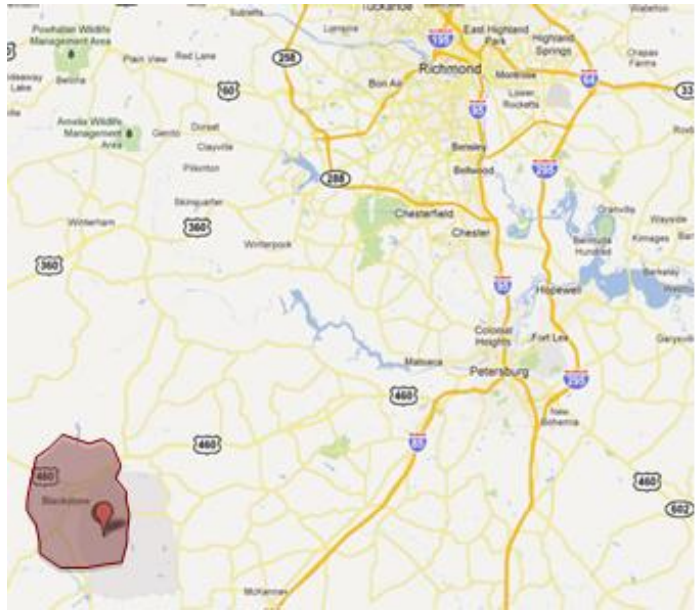


Figure 7: Fort Pickett Geography - Courtesy of Google Maps

Due to the campus's isolated location within the military base, as well as the magnitude of the site, space is not a constraining factor for construction. The Construction Manager's and Subcontractors' trailers were strategically placed north of the campus to allow easy access for visitors, as well as remain in close proximity to the Military Personnel occupying the Headquarters and Administration Building constructed in Phase I; this can be observed in more depth within Appendix C-1. In addition to the expansive area, streets completely surround the site and run in both directions making deliveries, parking, and site access incredibly easy in comparison to most construction environments. Although sidewalks extend from nearby parking lots, pedestrian traffic is very limited and not a primary safety concern for the project team.

During the construction of Phase I, underground utilities were installed for the future billeting buildings as part of the contract with Barton Malow. Upon winning Phase II, only minimal site MEP work was necessary for the construction of the barracks buildings. The existing utilities can be observed in Existing Conditions Site Plan, where the utilities are depicted using various colored lines and are distinguished between in the legend. The campus utilized a centralized utility system, which was believed to be more energy and cost effective. Two very unique features for the site involve the underground fire protection and glycol lines. The fire protection system is buffered by a fire pump house located north east of the site that is tapped into a nearby domestic water line. The fire pump house ensures that the fire protection system maintains adequate pressure for the sprinklers to combat potentially disastrous fires. Another unique feature is the mechanical system utilized throughout the campus. Each building operates a number of heat pumps that are heated or cooled by a glycol loop that runs throughout the campus. The glycol eventually makes its way back to the Headquarters and Administration Building where it can be treated and recirculated.

The site is surrounded by a 6’ chain linked fence and uses minimal security techniques, since the Military Base is protected by checkpoints and only allows authorized personnel on the site. Throughout the course of the project, portable toilets were located at both the north and the south parts of the site. Temporary power was located near the south entrance of the site, where it tapped into an existing line running south of the site, although this line is not depicted due to lack of documentation. Recycling and waste hoppers remained in consistent areas throughout the life of the project, near the south entrance and in the center of the campus.

Site Layout Planning

As the project progressed, the site remained relatively similar due to the large scale of the site, but throughout the various phases there was an influx of equipment, material storage spaces, working spaces, and laydown areas. Temporary roads, hoppers, equipment storage, and material storage locations remained fairly consistent throughout the life of the project, but a number of other things changed to accommodate the construction process from phase to phase.

The first phase to be looked into with more depth is the Excavation Phase, which can be referenced in Appendix C-2. Since the underground utilities for the billeting buildings were constructed during Phase I and the billeting buildings do not have a basement in the design, there was minimal excavation required. Continuous footers wrapped around the building perimeter with spread footers located at the column locations, but because of the favorable bearing soil, the footers only required 2'-3' of excavation. Since the foundations reached shallow depths, support of excavations was not necessary. Desired top soil was stored in a stock pile in the south-west corner of the site, while unneeded soil was hauled off site. The excavation process utilized a number of different equipment types, including excavators, dump trucks, backhoes, and lulls. As seen north of the site, Barton Malow's trailer was accompanied by the Sitework Subcontractor, as well as the newly mobilized Concrete Subcontractor in preparation for beginning foundation work. It can also be noticed that material storage had a presence in the south part of the site, but was at a minimal, since construction was just underway. Sequencing for can be observed on the site plan with construction starting at Building 700, moving to Building 500, and finishing at Building 600. This sequencing was utilized throughout the term of construction.

The next phase under analysis was the Superstructure Phase, which can be seen in further detail in Appendix C-3. As mentioned in the systems summaries, the structure is very different than typical construction. The superstructure consists of a minimal amount of structural steel and is primarily composed of cold formed metal studs to create load bearing walls. The first floor is slab on grade, the second floor is hollow-core planks, and the roof is metal trusses, which creates a number of different logistical situations throughout the Superstructure Phase. For the purpose of site planning, the placement of the hollow core planks is depicted in the Superstructure Phase Site Plan. During the placement of the hollow-core planks, the planks were placed along the length of the building with cranes on opposite sides of the building. In order to expedite the placement of the planks, the cranes alternated lifts. As the building was successfully completed, the crawler cranes were relocated to the next building.

The site plan depicts a number of changes from the previous phase of construction. Different equipment types and quantities were utilized for the Superstructure Phase, including the introduction of two crawler cranes. The material storage area was expanded and even stretched into the middle of the quadrangle to minimize traveling time for workers. The quadrangle also served as a laydown and staging area for the studs and structural steel. It can also be observed that the Framing Subcontractor mobilized a trailer on the south part of the site.

The last phase to be addressed was the Finishes Phase, which can be observed in further depth in Appendix C-4. The Finishes Phase varied the most from any other stage during the construction process, due to the sitework being performed and the number of Subcontractors involved. During this phase, Faulconer Construction began to spread top soil and place grass seed, which constricted the size of the job site. They also began to remove the temporary fences from areas that were seeded and started pouring concrete for sidewalks that were to stretch around the inside of the quadrangle. Another Subcontractor working on the exterior of the billeting buildings was the roofing trade. They utilized telescoping lifts in order to install gutters, soffit, fascia, and downspouts. Although materials remained in the quadrangle, there was a reduction in usable space as a result of the seeding.

Building construction inside the buildings consisted of the installation of ceramic tile in the bathrooms, resilient flooring, carpet, acoustical ceiling tile, switch plates, duct covers, window sills, and final paints. Although there were a number of different Subcontractors on site, the finish trades were small in comparison to the MEP trades, so they didn't hold trailers on site. In addition to installing finishes, punch list was started by Barton Malow and the Army Corps of Engineers, which consisted of compiling a punch list for one floor a week and giving the Subcontractors two weeks to correct the work. Like the other phases, a lull was used to lift materials into the building through the expansive windows at the ends of the buildings.

The logistics strategy utilized for the construction process was very efficient, gaining time on the schedule in every phase of the project. Due to the buffer in the schedule, the Finishes Phase was able to operate carefully to ensure a quality finished product. Due to the successful strategy implemented, there was little room to find improvement in the site logistics.

Local Conditions

The Regional Training Institute enacted construction methods typically used within the geographical region, as well as remained within common practices utilized by the Army Corps of Engineers. Although a steel structure was utilized on the billeting buildings, the system differed from traditional methods. As described in the systems summary section, the structural system mirrored residential construction by using cold formed steel studs as the primary structure of the building. This type of construction minimized specialized steel crews and focused more on framing crews for the construction of the buildings. In addition, the design was created to meet the simplistic, standardized approach of construction within the armed forces, which was reinforced by the buildings' façade. The façade featured split faced CMU placed by hand in horizontal bands displaying the colors of the Military. Although prefabricated CMU panels could have been a more efficient approach, the VAARNG chose to proceed with the traditional method of placing each block by hand for aesthetic purposes.

Due to the magnitude of the campus size, as well as the simplified campus layout, space on the jobsite was not an issue as seen on many other projects. As seen in Fig. 8 below, the jobsite was planned to maximize the space, as well as take advantage of the two entrances, although the south entrance was the primary entrance used. Prior to entering the site, workers' parking was located adjacent to the entrance. This was beneficial to Barton Malow, in order to reduce inefficient traveling times for breaks and lunch. It also made it advantageous to the workers, because tools could be transported over a short distance, reducing the need for vehicles to enter the site to deliver equipment and tools. Across the street from the site in the north were the CM's and Subcontractors' trailers. These were placed here to allow easy access from visitors, as well as to isolate themselves from the jobsite.

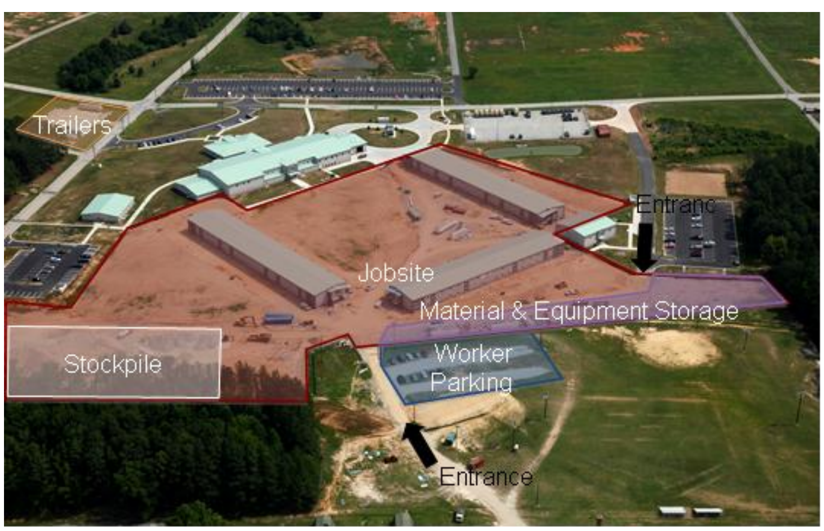


Figure 8: Aerial Photo - Courtesy of Barton Malow & Edited by Kendall Mahan

In order for Barton Malow to reach LEED goals, the handling of waste and recyclables was an item of key concern when constructing the billeting buildings. Within the general conditions, Barton Malow budgeted $40,000 to accommodate the disposal of waste and recyclables, but it was up to the project team to manage the proper disposal of materials. Within the LEED NC 2.2 checklist, Barton Malow strived to divert 75% of construction waste from disposal. This was critical, earning two points towards the projected LEED Silver rating.

The site is located in the southeastern region of Virginia's Piedmont Physiographic Province, which is characterized by igneous and metamorphic rocks underlying irregular plains and hills. The soil in this region is typically a combination of organic matter and bedrock residuum. The United States Department of Agriculture Soil Conversation Service's survey of the site indicated that the soils are mostly composed of fine sandy loams with moderate infiltration rates. The soils are well drained and have intermediate water retention capacities. A separate survey was conducted on July 26, 2007 by MM&A personnel that consisted of two soil borings. The soils encountered during this investigation ranged from sands and sandy clays grading with depth into saprolitic clays and quartz gravels.

Regarding the site hydrogeology, groundwater in the region is principally recharged by infiltration of precipitation into unconfined water table aquifers. Most of the unconfined groundwater flows relatively short distances and discharges into nearby streams, while some groundwater continues to flow downward to recharge deeper aquifers. During a July 26, 2007 limited subsurface investigation, depths to groundwater were estimated to be between 12 and 16 feet.

Client Information

The Virginia Army National Guard (VAARNG) serves as the acting owner of the Regional Training Institute at Fort Pickett Military Base. The Army National Guard is composed of acting forces from states, territories, and the District of Columbia across the country and is a fixture of the Army, along with the Active Army and the Army Reserve. The Army National Guard acts as a protector to both the State and Federal governments and primarily acts in times of emergencies, such as storms, natural disasters, and civil disturbances. The Army National Guard is composed of civilians who serve on a part time-basis.

Figure 9: VAARNG Logo - Courtesy of VAARNG

The billeting buildings have been in discussion for a number of years, but recently were approved for funding. The three billeting buildings are being constructed to replace the currently dilapidated barracks that were constructed during World War II. Many of the current billeting building at Fort Pickett are no longer suitable for living and are filled with dangerous materials, such as lead paint and asbestos.

In order to receive funding to construct the billeting buildings, legislation was passed within Congress, which made the total requested funds to be set in stone. For this reason, the budget was set in stone and cannot afford to overspend on the project. To help ensure that the financial aspects, as well as the quality, schedule, and safety issues were managed appropriately, the Army Corps of Engineers (COE) was hired to serve as the Owner's Representative.

The COE was incredibly involved in operations around the job site, including sitting in on Subcontractors' meetings, OAC meetings, safety stand-downs, inspections, quality control checks, and punch list items. In addition to serving as the Owner's Representative, the COE also served as the inspectors for all components of the building. By participating in the construction operation on a daily basis, it was beneficial to receive early input from a quality control and inspection aspect of the work; this eliminated future problems, since appropriate standards of work were established from the start of an activity. To further control the budget, the COE utilized a cost loaded schedule to ensure that activities were fully acceptable by quantity, as well as quality standards before sending payment to Barton Malow for their work.

The billeting buildings required no special sequencing or phasing, but for the purpose of construction, Barton Malow proceeded with a phased approach. This was believed to be in the best interest to Barton Malow, since it minimized the learning curve, maintained balanced crews, and allowed the punch list process to be staggered, an item of great benefit to the Quality Control Manager and Project Engineer on site. The plan proposed was to hand-over a building at a time, so that the VAARNG has the opportunity to spread its resources over a greater amount of time. In addition to providing a phased turn-over, Barton Malow was working with the VAARNG and COE on a daily basis to ensure that the building meets and exceeds the standards proposed in the RFP.

Project Delivery System

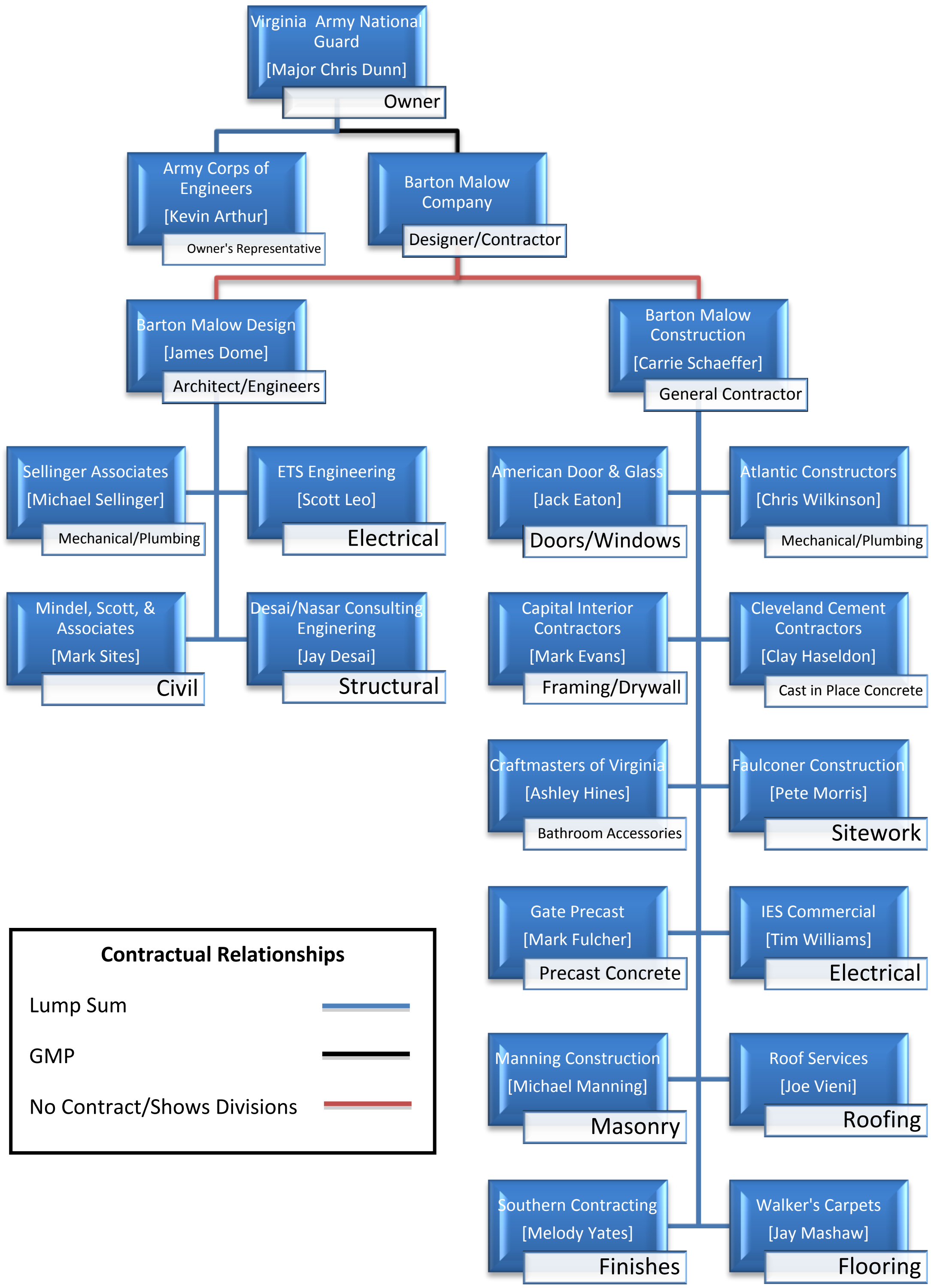


Figure 10: Project Delivery System - Developed by Kendall Mahan

Phase II of the Fort Pickett Regional Training Institute Project utilized a Design-Build delivery system with Barton Malow serving as the Designer/Builder. In addition, since it is a Department of Defense project, the Army Corps of Engineers served as the Owner's Representative to facilitate construction processes.

Since the project is a Department of Defense project, the delivery system was very unique to the typical private project. To begin the process, the Virginia Army National Guard filled out a Needs Assessment to the Military Contractor's Office to obtain support for funding. From there, the Military Contractor's Office reviewed the information and made a decision to proceed forward and request funds from Congress. Upon approval, a Construction Cost Limitation (CCL) was established by Congress, where the CCL contained the funds for representation, design, and construction services. From there, the Virginia Army National Guard brought aboard the Army Corps of Engineers (COE) to act as an Owner's Representative under a lump sum fee. The COE then began to perform research and conduct meetings with the Owner to get a better understanding of the needs of the Client. Once the needs of the Owner were clearly represented in the form of an RFP, the RFP was solicited on a website for companies to bid. The project was procured as a hard bid in the form of a Design-Build delivery system for two phases, but with the second phase being an option. At the end of the bidding process, in September of 2008, the lowest bidder, Barton Malow, was identified and awarded the project barring any complications, such as bonding. Upon successful completion of Phase I, Barton Malow was awarded Phase II for the amount of $28,177,099 in the form of a GMP. Within the GMP, Barton Malow built in a 3% fee at $850,000 with no shared savings clauses built in.

Barton Malow consists of a design and construction division, making the Design-Build approach an ideal opportunity for the company to succeed. Barton Malow had the advantage of acting as one entity, where other contractors were forced to collaborate and negotiate fees, budgets, and responsibilities with outside designers. Within Barton Malow Design, James Dome served as the lead individual and the Architect of Record. Although Barton Malow Design has some Engineers on staff, they received consultation from a number of Engineers, which can be seen in Figure 10 on the previous page.

Barton Malow Construction was responsible for the management and construction of the building process using a number of different Subcontractors. As seen in Fig. 10 on the previous page, twelve primary Subcontractors were responsible for the work, with each Subcontractor procured under a hard bid approach. Once the lowest bidder was identified, the contracts were then awarded using lump sum contracts. Due to the poor state of the economy, the work was awarded with negligible fees, although the GMP allowed for higher numbers, since the Subcontractors' work was awarded much later than the initial contract was awarded for from the Virginia Army National Guard. As a result, Barton Malow was able to capitalize on the opportunity and collect a greater fee than initially anticipated.

Regarding insurance, Barton Malow bonded the project for the full contract value. Barton Malow also maintained General Liability and Builder's Risk Insurance, where Barton Malow budgeted for $181,419 and $41,000 respectively to insure the required amounts specified in the RFP by the Virginia Army National Guard. In addition, Barton Malow's CCIP Program required that all subcontractors hold Worker's Compensation and Employer's Liability Insurance. Upon failure of the Subcontractor to acquire the specified insurance, Barton Malow held the right to provide the necessary insurance for them at the Subcontractors' expense. To further insure themself, Barton Malow also required all Subcontractors to submit a performance and payment bond, in the event of failure to meet obligations set forth in the contract. This ensured that Barton Malow was alleviated from any liability from problems associated with the work of the responsible Subcontractor.

As mentioned earlier, the Design-Build delivery method was the ideal delivery system for the project at hand. Using a Design-Build approach, the Owner was able to minimize responsible parties involved and use only one contract. Not only did this system benefit the Owner, but it was incredibly advantageous to Barton Malow, since it had the resources to conduct the design and construction services in-house. Although this was only Barton Malow's second project in the Federal field, their outstanding record from Phase I made them clear favorites to be awarded Phase II as well. Regarding the contract, the GMP was the most logical contract type, in order to ensure that there were minimal cost overruns, since the CCL was set in stone by Congress. Although, the Virginia Army National Guard had awarded the project under the CCL to allow for minimal cost overruns and potential change orders, there was very limited room for error, which made the use of a GMP the most appropriate contract choice.

Staffing Plan

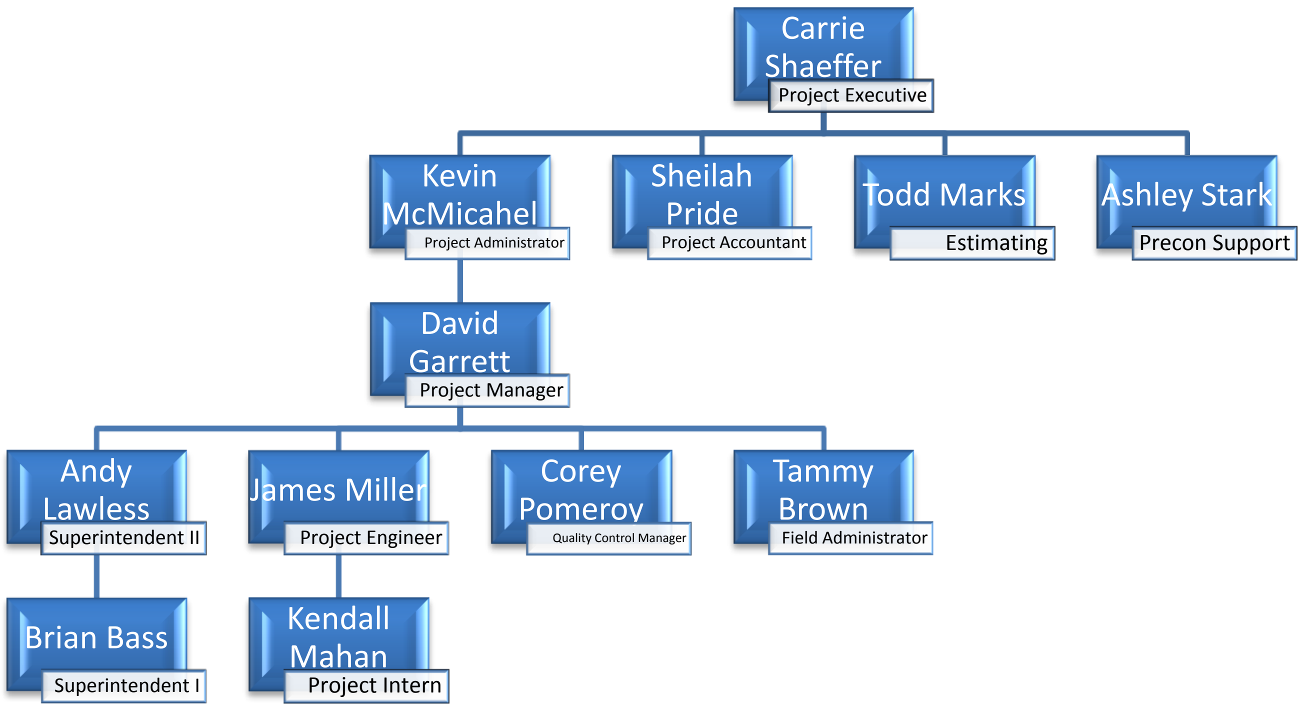


Figure 11: Staffing Plan - Developed by Kendall Mahan

Due to the successful turnover of Phase I, Barton Malow decided to employ a nearly identical staffing structure to that of Phase I with the addition of another Superintendent and Project Intern. For Phase II, Andy Lawless, Superintendent II, was brought onto site to add valuable experience to the project team, as well as provide opportunities to other members of the team to explore new roles. For the size of the project, the team was slightly overstaffed, but this allowed others to gain experience in new positions by creating a mentoring atmosphere.

Following the trend of a typical Barton Malow project team, the staff was led by Carrie Shaeffer, the Project Executive. She primarily worked out of the office, but was in charge of overseeing the project from the instance the RFP is posted to the day the project is turned over to the Owner. Kevin McMichael served as the Project Administrator, a similar role to the Project Executive, but was more focused on a smaller group of projects, typically 3-5. His role was primarily based out of the office, but made frequent trips to ensure that operations were running properly. In addition to these players on the project team based out of the office, the team also consisted of a Preconstruction Support, Estimator, and Accountant.

The leader on site was David Garrett, the Project Manager. He was ultimately responsible for the success of the project and handled the day-to-day operations of the site. In addition to the Project Manager, the project staffs two Superintendents, Project Engineer, Quality Control Manager, Field Administrator, and Project Intern. The members of this team were responsible for their own individual tasks, but all share a focus and responsibility to deliver the project on time and ahead of schedule. Each member brought their own level of experience, but because of their collaborative work environment, every member continued to develop and became a greater asset to the company.

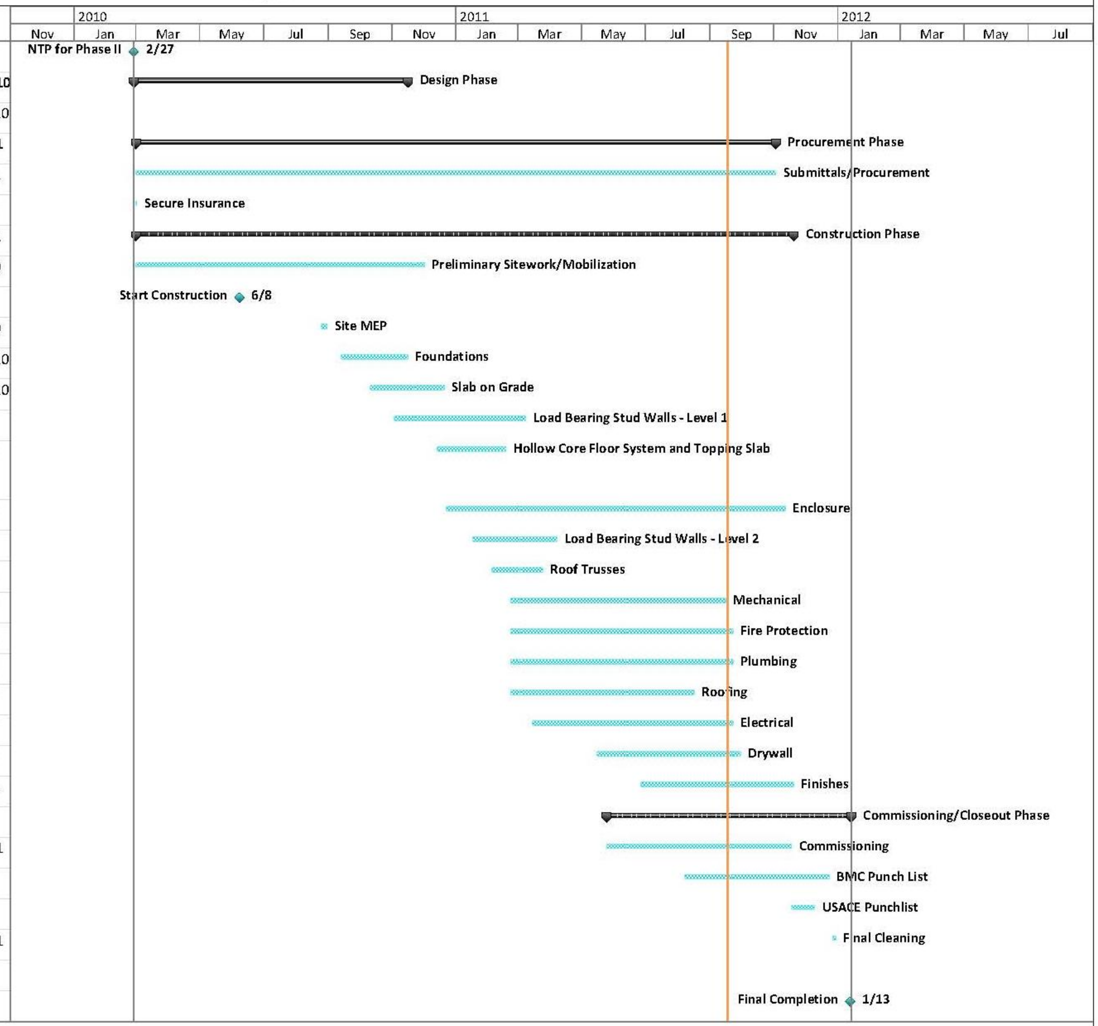
One position that was unique to this project was the Quality Control Manager. Following the guidelines of the RFP and any federal project, a Quality Control Manager was required to be on site to facilitate quality control between the CM team and the Army Corps of Engineers. This unique position consisted of recording daily reports, toolbox talks, inspections, and punch list items.

Appendix A

Project Summary Schedule

Project1

ID	Task Name	Duration	Start	Finish
1	NTP for Phase II	0 days	Sat 2/27/10	Sat 2/27/10
2	**Design Phase**	**187 days**	**Sat 2/27/10**	**Mon 11/15/10**
3	Design, Drawings, Review	187 days	Sat 2/27/10	Mon 11/15/10
4	**Procurement Phase**	**438 days**	**Mon 3/1/10**	**Wed 11/2/11**
5	Submittals/Procurement	438 days	Mon 3/1/10	Wed 11/2/11
6	Secure Insurance	1 day	Mon 3/1/10	Mon 3/1/10
7	**Construction Phase**	**450 days**	**Mon 3/1/10**	**Sat 11/19/11**
8	Preliminary Sitework/Mobilization	198 days	Mon 3/1/10	Wed 12/1/10
9	Start Construction	0 days	Tue 6/8/10	Tue 6/8/10
10	Site MEP	4 days	Wed 8/25/10	Mon 8/30/10
11	Foundations	46 days	Mon 9/13/10	Mon 11/15/10
12	Slab on Grade	51 days	Mon 10/11/10	Mon 12/20/10
13	Load Bearing Stud Walls - Level 1	90 days	Wed 11/3/10	Tue 3/8/11
14	Hollow Core Floor System and Topping Slab	48 days	Tue 12/14/10	Thu 2/17/11
15	Enclosure	232 days	Thu 12/23/10	Fri 11/11/11
16	Load Bearing Stud Walls - Level 2	59 days	Mon 1/17/11	Thu 4/7/11
17	Roof Trusses	35 days	Fri 2/4/11	Thu 3/24/11
18	Mechanical	148 days	Tue 2/22/11	Thu 9/15/11
19	Fire Protection	153 days	Tue 2/22/11	Thu 9/22/11
20	Plumbing	153 days	Tue 2/22/11	Thu 9/22/11
21	Roofing	126 days	Tue 2/22/11	Tue 8/16/11
22	Electrical	138 days	Tue 3/15/11	Thu 9/22/11
23	Drywall	99 days	Mon 5/16/11	Thu 9/29/11
24	Finishes	106 days	Mon 6/27/11	Sat 11/19/11
25	**Commissioning/Closeout Phase**	**168 days**	**Wed 5/25/11**	**Fri 1/13/12**
26	Commissioning	127 days	Wed 5/25/11	Thu 11/17/11
27	BMC Punch List	100 days	Mon 8/8/11	Fri 12/23/11
28	USACE Punchlist	16 days	Fri 11/18/11	Fri 12/9/11
29	Final Cleaning	3 days	Tue 12/27/11	Thu 12/29/11
30	Final Inspection	1 day	Fri 1/13/12	Fri 1/13/12
31	Final Completion	0 days	Fri 1/13/12	Fri 1/13/12



Critical Progress, Task, Split, Task Progress, Manual Task, Start-only, Finish-only, Duration-only, Baseline, Baseline Split, Baseline Milestone, Milestone, Summary Progress, Summary, Manual Summary, Project Summary, External Tasks, External Milestone, Inactive Task, Inactive Milestone, Inactive Summary, Deadline

Kendall Mahan
Project Summary Schedule
Date: 9/23/11

Fort Picket Regional Training Institute Phase II
Blackstone, VA

Appendix B-1

RSMeans CostWorks Square Foot Estimate (Buildings 500/700)

Square Foot Cost Estimate Report

Estimate Name:	**Fort Pickett Regional Training Institute Phase II**
	Virginia Army National Guard
	Blackstone
	Virginia
Building Type:	**College, Dormitory, 2-3 Story with Decorative Concrete Block / Steel Frame**
Location:	PETERSBURG, VA
Stories Count (L.F.):	**2.00**
Stories Height	**11.83**
Floor Area (S.F.):	**40,428.00**
LaborType	**Open Shop**
Basement Included:	No
Data Release:	**Year 2011 Quarter 3**
Cost Per Square Foot	**$119.68**
Total Building Cost	**$4,838,500**

Costs are derived from a building model with basic components. Scope differences and market conditions can cause costs to vary significantly.

		% of Total	Cost Per SF	Cost
A Substructure		**4.4%**	**5.11**	**$206,500**
A1010	**Standard Foundations**		**1.74**	**$70,500**
	Strip footing, concrete, reinforced, load 5.1 KLF, soil bearing capacity 3 KSF, 12" deep x 24" wide			
	Spread footings, 3000 PSI concrete, load 100K, soil bearing capacity 6 KSF, 4' - 6" square x 15" deep			
	Spread footings, 3000 PSI concrete, load 150K, soil bearing capacity 6 KSF, 5' - 6" square x 18" deep			
A1030	**Slab on Grade**		**2.09**	**$84,500**
	Slab on grade, 4" thick, non industrial, reinforced			
A2010	**Basement Excavation**		**0.05**	**$2,000**
	Excavate and fill, 30,000 SF, 4' deep, sand, gravel, or common earth, on site storage			
A2020	**Basement Walls**		**1.22**	**$49,500**
	Foundation wall, CIP, 4' wall height, direct chute, .148 CY/LF, 7.2 PLF, 12" thick			
B Shell		**29.4%**	**34.17**	**$1,381,500**
B1010	**Floor Construction**		**16.02**	**$647,500**
	Steel column, W14, 300 KIPS, 10' unsupported height, 61 PLF			
	Floor, composite concrete slab on fireproofed W beam, 4" slab, 20'x25' bay, 20" total depth, 75 PSF superimposed l			
B1020	**Roof Construction**		**7.84**	**$317,000**
	Floor, composite slab on steel beam, 20'x25' bay, 4"slab, 20 " total depth40 PSF superimposed load, 94 PSF total lo			
B2010	**Exterior Walls**		**4.30**	**$174,000**
	Concrete block (CMU) wall, split rib, 8 ribs, hollow, regular weight, 8x8x16, reinforced, vertical #5@32", grouted			
B2020	**Exterior Windows**		**2.83**	**$114,500**
	Windows, aluminum, awning, insulated glass, 4'-5" x 5'-3"			
B2030	**Exterior Doors**		**1.16**	**$47,000**
	Door, aluminum & glass, without transom, full vision, double door, hardware, 6'-0" x 7'-0" opening			
B3010	**Roof Coverings**		**2.02**	**$81,500**
	Roofing, single ply membrane, EPDM, 60 mils, loosely laid, stone ballast			
	Insulation, rigid, roof deck, composite with 2" EPS, 1" perlite			
	Roof edges, aluminum, duranodic, .050" thick, 6" face			
	Flashing, aluminum, no backing sides, .019"			

1

		% of Total	Cost Per SF	Cost
	Gravel stop, aluminum, extruded, 4", mill finish, .050" thick			
C Interiors		**21.9%**	**25.44**	**$1,028,500**
C1010	**Partitions**		**4.65**	**$188,000**
	Concrere block (CMU) partition, light weight, hollow, 8" thick, no finish			
	Metal partition, 5/8" water resistant gypsum board face, 5/8"fire rated gypsum board base, 3-5/8" @ 24", 5/8"fire rat			
C1020	**Interior Doors**		**5.59**	**$226,000**
	Door, single leaf, wood frame, 3'-0" x 7'-0" x 1-3/8", birch, solid core			
C1030	**Fittings**		**1.56**	**$63,000**
	Bathroom accessories, stainless steel, mirror, framed, with shelf, 72" x 24"			
C2010	**Stair Construction**		**1.77**	**$71,500**
	Stairs, CIP concrete, w/landing, 12 risers, with nosing			
C3010	**Wall Finishes**		**2.40**	**$97,000**
	2 coats paint on masonry with block filler			
	Painting, interior on plaster and drywall, walls & ceilings, roller work, primer & 2 coats			
	Painting, masonry or concrete, latex, brushwork, primer & 2 coats			
	Ceramic tile, thin set, 4-1/4" x 4-1/4"			
C3020	**Floor Finishes**		**8.78**	**$355,000**
	Carpet, tufted, nylon, roll goods, 12' wide, 36 oz			
	Carpet, padding, add to above, minimum			
	Vinyl, composition tile, minimum			
	Vinyl, composition tile, maximum			
	Tile, ceramic natural clay			
C3030	**Ceiling Finishes**		**0.69**	**$28,000**
	Paint on plaster or drywall, roller work, primer + 1 coat			
	Acoustic ceilings, 3/4" fiberglass board, 24" x 48" tile, tee grid, suspended support			
D Services		**40.5%**	**47.01**	**$1,900,500**
D1010	**Elevators and Lifts**		**4.25**	**$172,000**
	Hydraulic passenger elevator, 4000 lb., 3 floor, 12' story height, 125 FPM			
D2010	**Plumbing Fixtures**		**15.61**	**$631,000**
	Water closet, vitreous china, bowl only with flush valve, wall hung			
	Lavatory w/trim, wall hung, vitreous china, 19" x 17"			
	Kitchen sink w/trim, countertop, PE on CI, 32" x 21" double bowl			
	Laundry sink w/trim, plastic, on wall or legs, 36" x 23" double compartment			
	Service sink w/trim, PE on CI,wall hung w/rim guard, 22" x 18"			
	Bathtub, recessed, PE on CI, mat bottom, 5' long			
	Shower, stall, fiberglass 1 piece, three walls, 36" square			
	Water cooler, electric, wall hung, wheelchair type, 7.5 GPH			
D2020	**Domestic Water Distribution**		**2.05**	**$83,000**
	Electric water heater, commercial, 100< F rise, 500 gal, 240 KW 984 GPH			
D2040	**Rain Water Drainage**		**0.20**	**$8,000**
	Roof drain, CI, soil,single hub, 5" diam, 10' high			
	Roof drain, CI, soil,single hub, 5" diam, for each additional foot add			
D3050	**Terminal & Package Units**		**8.84**	**$357,500**
	Rooftop, multizone, air conditioner, medical centers, 25,000 SF, 58.33 ton			
D4010	**Sprinklers**		**1.92**	**$77,500**
	Wet pipe sprinkler systems, steel, light hazard, 1 floor, 10,000 SF			
	Wet pipe sprinkler systems, steel, light hazard, each additional floor, 10,000 SF			
D4020	**Standpipes**		**0.54**	**$22,000**
	Dry standpipe risers, class III, steel, black, sch 40, 6" diam pipe, 1 floor			
	Dry standpipe risers, class III, steel, black, sch 40, 6" diam pipe, additional floors			

2

		% of Total	Cost Per SF	Cost
D5010	**Electrical Service/Distribution**		1.43	$58,000
	Service installation, includes breakers, metering, 20' conduit & wire, 3 phase, 4 wire, 120/208 V, 800 A			
	Feeder installation 600 V, including RGS conduit and XHHW wire, 800 A			
	Switchgear installation, incl switchboard, panels & circuit breaker, 800 A			
D5020	**Lighting and Branch Wiring**		6.84	$276,500
	Receptacles incl plate, box, conduit, wire, 20 per 1000 SF,2.4 watts per SF			
	Wall switches, 2.5 per 1000 SF			
	Miscellaneous power, to .5 watts			
	Central air conditioning power, 4 watts			
	Motor installation, three phase, 200 V, 15 HP motor size			
	Motor feeder systems, three phase, feed to 200 V 15 HP, 230 V 15 HP, 460 V 40 HP, 575 V 50 HP			
	Fluorescent fixtures recess mounted in ceiling, 0.8 watt per SF, 20 FC, 5 fixtures @32 watt per 1000 SF			
D5030	**Communications and Security**		5.24	$212,000
	Telephone wiring for offices & laboratories, 8 jacks/MSF			
	Communication and alarm systems, fire detection, addressable, 25 detectors, includes outlets, boxes, conduit and w			
	Fire alarm command center, addressable with voice, excl. wire & conduit			
	Communication and alarm systems, includes outlets, boxes, conduit and wire, intercom systems, 25 stations			
	Communication and alarm systems, includes outlets, boxes, conduit and wire, master TV antenna systems, 12 outle			
	Internet wiring, 8 data/voice outlets per 1000 S.F.			
D5090	**Other Electrical Systems**		0.07	$3,000
	Generator sets, w/battery, charger, muffler and transfer switch, gas/gasoline operated, 3 phase, 4 wire, 277/480 V, 7			
E Equipment & Furnishings		3.8%	4.46	$180,500
E1090	**Other Equipment**		0.51	$20,500
	88 - Detection Systems, heat detector, smoke detector, ceiling type, excl. wires & conduit			
E2020	**Moveable Furnishings**		3.96	$160,000
	Furnishings, dormitory furniture, dressing unit, built-in, deluxe			
F Special Construction		0.0%	0.00	$0
G Building Sitework		0.0%	0.00	$0
Sub Total		**100%**	**$116.19**	**$4,697,500**
Contractor's Overhead & Profit		**3.0%**	**$3.49**	**$141,000**
Architectural Fees		**0.0%**	**$0.00**	**$0**
User Fees		**0.0%**	**$0.00**	**$0**
Total Building Cost			**$119.68**	**$4,838,500**

3

Appendix B-2

RSMeans CostWorks Square Foot Estimate (Building 600)

Square Foot Cost Estimate Report

Estimate Name:	**Fort Pickett Regional Training Institute Phase II**
	Virginia Army National Guard
	Blackstone
	Virginia
Building Type:	**College, Dormitory, 2-3 Story with Decorative Concrete Block / Steel Frame**
Location:	PETERSBURG, VA
Stories Count (L.F.):	**2.00**
Stories Height	**11.83**
Floor Area (S.F.):	**35,544.00**
LaborType	**Open Shop**
Basement Included:	No
Data Release:	**Year 2011 Quarter 3**
Cost Per Square Foot	**$120.40**
Total Building Cost	**$4,279,500**

Costs are derived from a building model with basic components. Scope differences and market conditions can cause costs to vary significantly.

		% of Total	Cost Per SF	Cost
A Substructure		**4.4%**	**5.15**	**$183,000**
A1010	**Standard Foundations**		**1.76**	**$62,500**
	Strip footing, concrete, reinforced, load 5.1 KLF, soil bearing capacity 3 KSF, 12" deep x 24" wide			
	Spread footings, 3000 PSI concrete, load 100K, soil bearing capacity 6 KSF, 4' - 6" square x 15" deep			
	Spread footings, 3000 PSI concrete, load 150K, soil bearing capacity 6 KSF, 5' - 6" square x 18" deep			
A1030	**Slab on Grade**		**2.10**	**$74,500**
	Slab on grade, 4" thick, non industrial, reinforced			
A2010	**Basement Excavation**		**0.06**	**$2,000**
	Excavate and fill, 30,000 SF, 4' deep, sand, gravel, or common earth, on site storage			
A2020	**Basement Walls**		**1.24**	**$44,000**
	Foundation wall, CIP, 4' wall height, direct chute, .148 CY/LF, 7.2 PLF, 12" thick			
B Shell		**28.4%**	**34.31**	**$1,219,500**
B1010	**Floor Construction**		**16.02**	**$569,500**
	Steel column, W14, 300 KIPS, 10' unsupported height, 61 PLF			
	Floor, composite concrete slab on fireproofed W beam, 4" slab, 20'x25' bay, 20" total depth, 75 PSF superimposed lo			
B1020	**Roof Construction**		**7.84**	**$278,500**
	Floor, composite slab on steel beam, 20'x25' bay, 4"slab, 20 " total depth40 PSF superimposed load, 94 PSF total lo			
B2010	**Exterior Walls**		**4.37**	**$155,500**
	Concrete block (CMU) wall, split rib, 8 ribs, hollow, regular weight, 8x8x16, reinforced, vertical #5@32", grouted			
B2020	**Exterior Windows**		**2.88**	**$102,500**
	Windows, aluminum, awning, insulated glass, 4'-5" x 5'-3"			
B2030	**Exterior Doors**		**1.17**	**$41,500**
	Door, aluminum & glass, without transom, full vision, double door, hardware, 6'-0" x 7'-0" opening			
B3010	**Roof Coverings**		**2.03**	**$72,000**
	Roofing, single ply membrane, EPDM, 60 mils, loosely laid, stone ballast			
	Insulation, rigid, roof deck, composite with 2" EPS, 1" perlite			
	Roof edges, aluminum, duranodic, .050" thick, 6" face			
	Flashing, aluminum, no backing sides, .019"			

1

		% of Total	Cost Per SF	Cost
	Gravel stop, aluminum, extruded, 4", mill finish, .050" thick			
C Interiors		**21.8%**	**25.46**	**$905,000**
C1010	**Partitions**		**4.66**	**$165,500**
	Concrere block (CMU) partition, light weight, hollow, 8" thick, no finish			
	Metal partition, 5/8" water resistant gypsum board face, 5/8"fire rated gypsum board base, 3-5/8" @ 24", 5/8"fire rat			
C1020	**Interior Doors**		**5.58**	**$198,500**
	Door, single leaf, wood frame, 3'-0" x 7'-0" x 1-3/8", birch, solid core			
C1030	**Fittings**		**1.56**	**$55,500**
	Bathroom accessories, stainless steel, mirror, framed, with shelf, 72" x 24"			
C2010	**Stair Construction**		**1.77**	**$63,000**
	Stairs, CIP concrete, w/landing, 12 risers, with nosing			
C3010	**Wall Finishes**		**2.41**	**$85,500**
	2 coats paint on masonry with block filler			
	Painting, interior on plaster and drywall, walls & ceilings, roller work, primer & 2 coats			
	Painting, masonry or concrete, latex, brushwork, primer & 2 coats			
	Ceramic tile, thin set, 4-1/4" x 4-1/4"			
C3020	**Floor Finishes**		**8.79**	**$312,500**
	Carpet, tufted, nylon, roll goods, 12' wide, 36 oz			
	Carpet, padding, add to above, minimum			
	Vinyl, composition tile, minimum			
	Vinyl, composition tile, maximum			
	Tile, ceramic natural clay			
C3030	**Ceiling Finishes**		**0.69**	**$24,500**
	Paint on plaster or drywall, roller work, primer + 1 coat			
	Acoustic ceilings, 3/4" fiberglass board, 24" x 48" tile, tee grid, suspended support			
D Services		**40.7%**	**47.56**	**$1,690,500**
D1010	**Elevators and Lifts**		**4.25**	**$151,000**
	Hydraulic passenger elevator, 4000 lb., 3 floor, 12' story height, 125 FPM			
D2010	**Plumbing Fixtures**		**15.60**	**$554,500**
	Water closet, vitreous china, bowl only with flush valve, wall hung			
	Lavatory w/trim, wall hung, vitreous china, 19" x 17"			
	Kitchen sink w/trim, countertop, PE on CI, 32" x 21" double bowl			
	Laundry sink w/trim, plastic, on wall or legs, 36" x 23" double compartment			
	Service sink w/trim, PE on CI,wall hung w/rim guard, 22" x 18"			
	Bathtub, recessed, PE on CI, mat bottom, 5' long			
	Shower, stall, fiberglass 1 piece, three walls, 36" square			
	Water cooler, electric, wall hung, wheelchair type, 7.5 GPH			
D2020	**Domestic Water Distribution**		**2.34**	**$83,000**
	Electric water heater, commercial, 100< F rise, 500 gal, 240 KW 984 GPH			
D2040	**Rain Water Drainage**		**0.23**	**$8,000**
	Roof drain, CI, soil,single hub, 5" diam, 10' high			
	Roof drain, CI, soil,single hub, 5" diam, for each additional foot add			
D3050	**Terminal & Package Units**		**8.83**	**$314,000**
	Rooftop, multizone, air conditioner, medical centers, 25,000 SF, 58.33 ton			
D4010	**Sprinklers**		**1.91**	**$68,000**
	Wet pipe sprinkler systems, steel, light hazard, 1 floor, 10,000 SF			
	Wet pipe sprinkler systems, steel, light hazard, each additional floor, 10,000 SF			
D4020	**Standpipes**		**0.53**	**$19,000**
	Dry standpipe risers, class III, steel, black, sch 40, 6" diam pipe, 1 floor			
	Dry standpipe risers, class III, steel, black, sch 40, 6" diam pipe, additional floors			

2

		% of Total	Cost Per SF	Cost
D5010	**Electrical Service/Distribution**		1.63	$58,000
	Service installation, includes breakers, metering, 20' conduit & wire, 3 phase, 4 wire, 120/208 V, 800 A			
	Feeder installation 600 V, including RGS conduit and XHHW wire, 800 A			
	Switchgear installation, incl switchboard, panels & circuit breaker, 800 A			
D5020	**Lighting and Branch Wiring**		6.86	$244,000
	Receptacles incl plate, box, conduit, wire, 20 per 1000 SF,2.4 watts per SF			
	Wall switches, 2.5 per 1000 SF			
	Miscellaneous power, to .5 watts			
	Central air conditioning power, 4 watts			
	Motor installation, three phase, 200 V, 15 HP motor size			
	Motor feeder systems, three phase, feed to 200 V 15 HP, 230 V 15 HP, 460 V 40 HP, 575 V 50 HP			
	Fluorescent fixtures recess mounted in ceiling, 0.8 watt per SF, 20 FC, 5 fixtures @32 watt per 1000 SF			
D5030	**Communications and Security**		5.29	$188,000
	Telephone wiring for offices & laboratories, 8 jacks/MSF			
	Communication and alarm systems, fire detection, addressable, 25 detectors, includes outlets, boxes, conduit and w			
	Fire alarm command center, addressable with voice, excl. wire & conduit			
	Communication and alarm systems, includes outlets, boxes, conduit and wire, intercom systems, 25 stations			
	Communication and alarm systems, includes outlets, boxes, conduit and wire, master TV antenna systems, 12 outle			
	Internet wiring, 8 data/voice outlets per 1000 S.F.			
D5090	**Other Electrical Systems**		0.08	$3,000
	Generator sets, w/battery, charger, muffler and transfer switch, gas/gasoline operated, 3 phase, 4 wire, 277/480 V, 7			
E Equipment & Furnishings		3.8%	4.42	$157,000
E1090	**Other Equipment**		0.46	$16,500
	72 - Detection Systems, heat detector, smoke detector, ceiling type, excl. wires & conduit			
E2020	**Moveable Furnishings**		3.95	$140,500
	Furnishings, dormitory furniture, dressing unit, built-in, deluxe			
F Special Construction		0.0%	0.00	$0
G Building Sitework		0.0%	0.00	$0
Sub Total		100%	$116.90	$4,155,000
Contractor's Overhead & Profit		3.0%	$3.50	$124,500
Architectural Fees		0.0%	$0.00	$0
User Fees		0.0%	$0.00	$0
Total Building Cost			$120.40	$4,279,500

3

Appendix B-3

RSMeans CostWorks Assemblies Estimate

Virginia Army National Guard

Blackstone,

Year 2011 Quarter 3

Date: 21-Sep-11

Assembly Detail Report

Cost Estimate Report
CostWorks
RSMeans

Fort Pickett Regional Training Institute Phase II

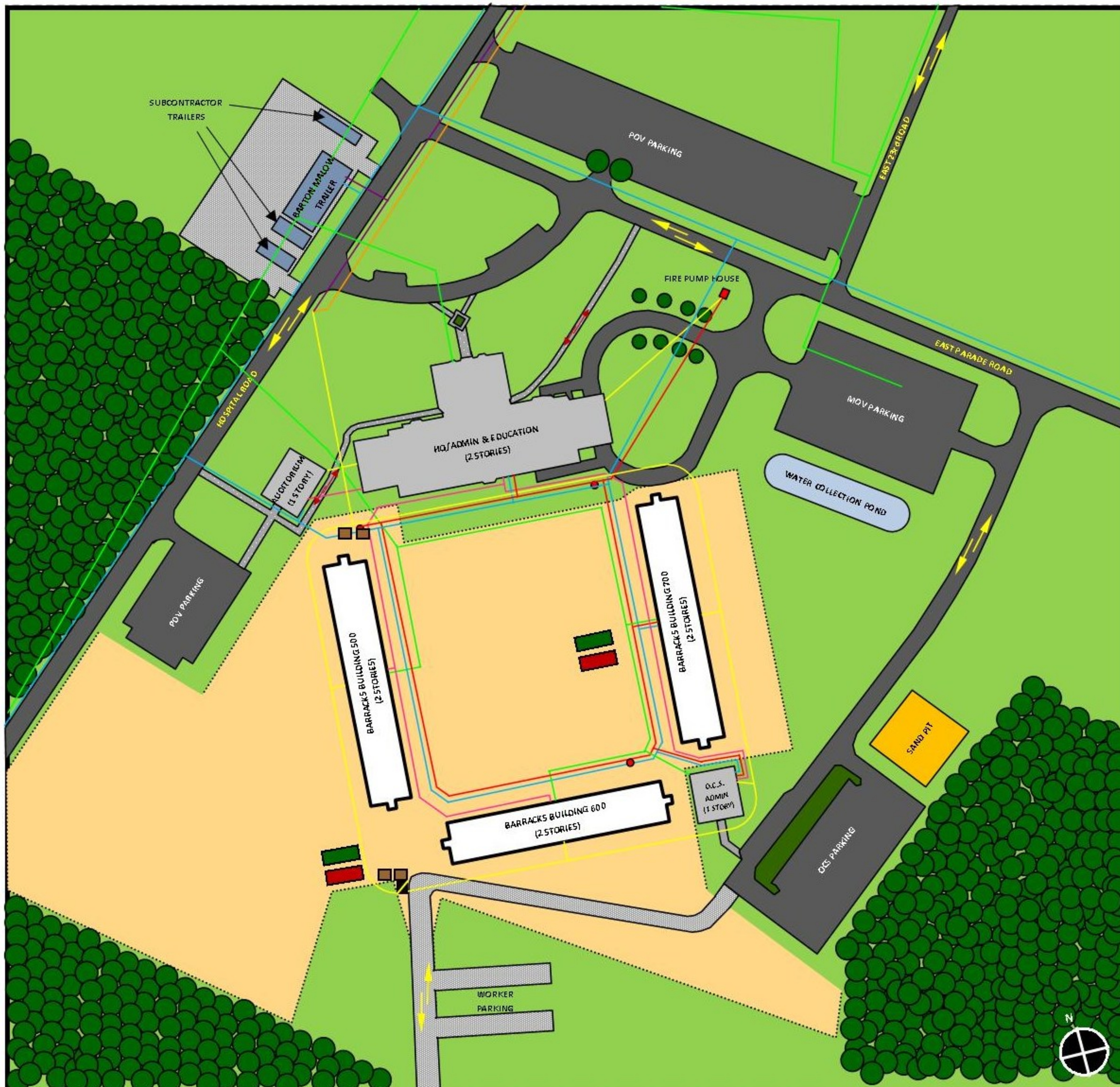
Prepared By:
Kendall Mahan
Penn State University

Assembly Number	Description	Quantity	Unit	Total Incl. O&P	Ext. Total Incl. O&P
D Services					
D20101101920	Water closet, vitreous china, tank type, floor mount, 1 piece	120.00	Ea.	$1,872.03	$224,643.60
D20103101920	Lavatory w/trim, vanity top, vitreous china, 20" x 16"	217.00	Ea.	$1,050.30	$227,915.10
D20107101560	Shower, stall, baked enamel, molded stone receptor, 30" square	120.00	Ea.	$1,655.94	$198,712.80
D20108101880	Drinking fountain, 1 bubbler, wall mounted, non recessed, fiberglass, 12" back	6.00	Ea.	$2,478.00	$14,868.00
D20202402260	Electric water heater, commercial, 100< F rise, 500 gal, 240 KW 984 GPH	1.00	Ea.	$53,112.00	$53,112.00
D20402106200	Roof drain, steel galv sch 40 threaded, 4" diam piping, 10' high	24.00	Ea.	$2,777.55	$66,661.20
D20402106240	Roof drain, steel galv sch 40 threaded, 4" diam piping, for each additional foot add	240.00	Ea.	$69.11	$16,586.40
D20908101300	Copper tubing, hard temper, solder, type K, 1-1/4" diameter	9,330.00	L.F.	$22.84	$213,097.20
D30201041520	Large heating systems, electric boilers, hydronic, 149,000 SF, 2,400 KW, 8,191 MBH, 8 floors	116,400.00	S.F.	$5.23	$608,772.00
D30301151520	Packaged chiller, water cooled, with fan coil unit, apartment corridors, 60,000 SF, 110.00 ton	116,400.00	S.F.	$6.20	$721,680.00
D30402301010	Utility fan set system, belt drive, 2000 CFM	3.00	Ea.	$8,782.05	$26,346.15
D30502401050	Heat pump, horizontal, ducted, water source, 3 ton	61.00	Ea.	$8,475.68	$517,016.48
D40104100640	Wet pipe sprinkler systems, steel, light hazard, 1 floor, 50,000 SF	58,200.00	S.F.	$2.10	$122,220.00
D40104100760	Wet pipe sprinkler systems, steel, light hazard, each additional floor, 50,000 SF	58,200.00	S.F.	$1.51	$87,882.00
D40203101620	Wet standpipe risers, class III, steel, black, sch 40, 8" diam pipe, 1 floor	3.00	Floor	$14,215.50	$42,646.50
D40203101640	Wet standpipe risers, class III, steel, black, sch 40, 8" diam pipe, additional floors	3.00	Floor	$3,452.15	$10,356.45
D40909100040	Detectors with brackets, fixed temperature heat detector	248.00	Ea.	$96.61	$23,959.28
D40909100440	Control station, single zone control station with batteries	6.00	Ea.	$1,953.18	$11,719.08
D40909100550	Manual pull station	24.00	Ea.	$116.46	$2,795.04
D40909100740	Bell signalling device	24.00	Ea.	$120.37	$2,888.88
D50101100720	High voltage cable, neutral & conduit included, copper 4/0, 25 KV	9,330.00	L.F.	$81.07	$756,383.10
D50101200400	Service installation, includes breakers, metering, 20' conduit & wire, 3 phase, 4 wire, 120/208 V, 800 A	3.00	Ea.	$14,382.00	$43,146.00
D50101200570	Svce inst,incls bkrs,mtng,20' cnd & wire,3 ph, add 25% for 277/480 V	3.00			$0.00
D50102300400	Feeder installation 600 V, including RGS conduit and XHHW wire, 800 A	60.00	L.F.	$221.66	$13,299.60
D50102400280	Switchgear installation, incl switchboard, panels & circuit breaker, 800 A	3.00	Ea.	$23,445.00	$70,335.00
D50201250560	Receptacle duplex 120 V grounded, 20 A with box, plate, 3/4" EMT & wire	1,380.00	Ea.	$201.50	$278,070.00
D50201250640	Receptacle duplex G.F.I. 20 A with box, plate, 3/4" EMT & wire	240.00	Ea.	$233.43	$56,023.20

Assembly Number			Description	Quantity	Unit	Total Incl. O&P	Ext. Total Incl. O&P
D50201250720			Toggle switch single pole, 20 A with box, plate, 3/4" EMT & wire	638.00	Ea.	$197.83	$126,215.54
D50202081560			Fluorescent fixtures, type C, 101 fixtures per 5000 SF	116,400.00	S.F.	$8.96	$1,042,944.00
D Services Subtotal							**$5,580,294.60**

Appendix C-1

Site Plan – Existing Conditions



FORT PICKETT REGIONAL TRAINING INSTITUTE PHASE II

BLACKSTONE, VIRGINIA

SEPTEMBER 23, 2011

KENDALL MAHAN

EXISTING CONDITIONS

SYMBOLS

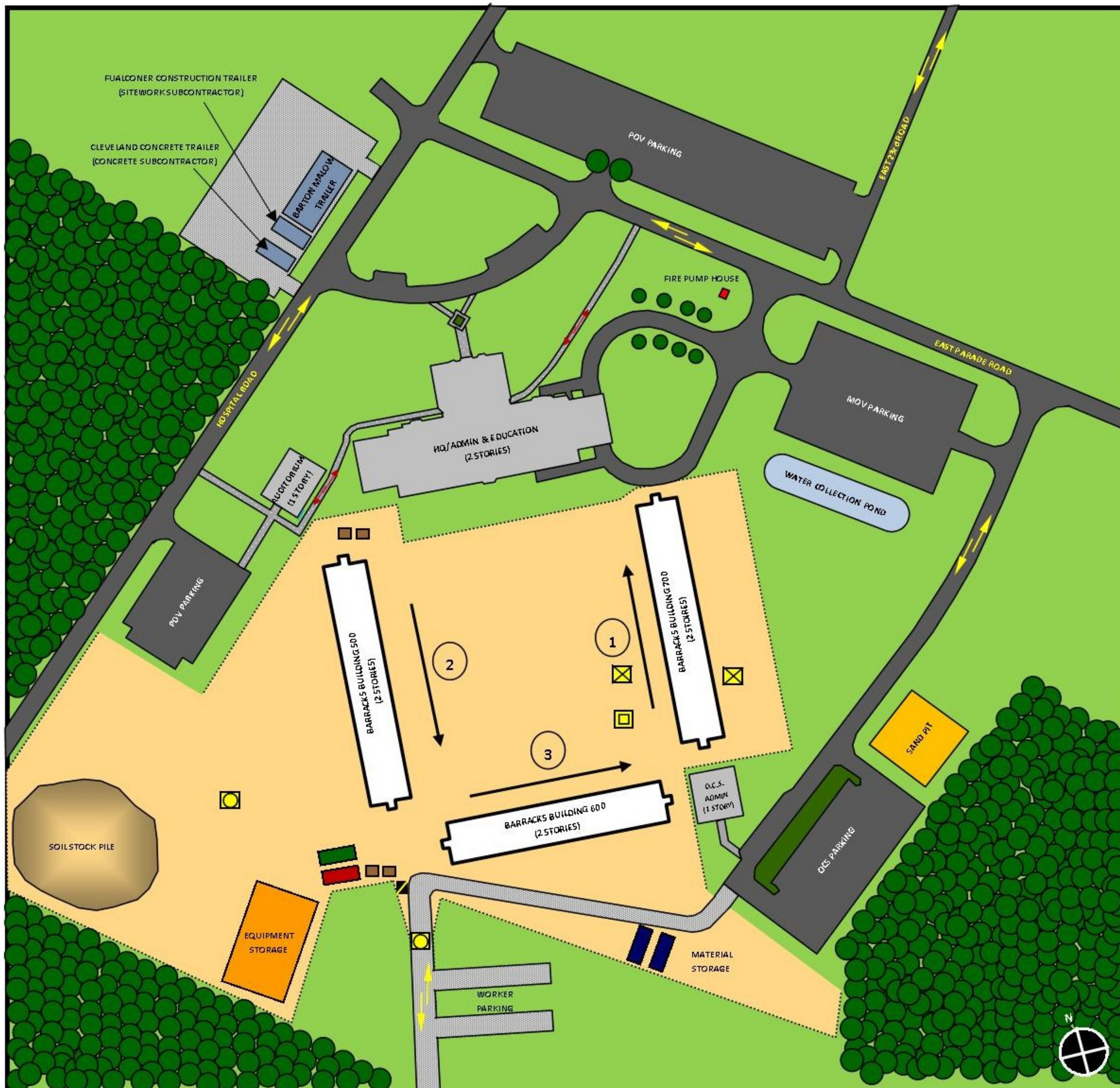
NEW BUILDINGS
EXISTING BUILDINGS
CONSTRUCTION TRAILERS
PEDESTRIAN WALKWAY
TEMPORARY PARKING/ROADS
VEHICULAR TRAFFIC
PEDESTRIAN TRAFFIC
CONSTRUCTION FENCE
RECYCLING CONTAINER
WASTE CONTAINER
FIRE HYDRANT
PORTABLE TOILET
TEMPORARY POWER

EXISTING UTILITIES

SANITARY/SEWAGE
DOMESTIC WATER
FIRE WATER
ELECTRIC/TELEPHONE
GLYCOL SUPPLY/RETURN
OVERHEAD ELECTRIC
OVERHEAD TELEPHONE

Appendix C-2

Site Plan – Excavation Phase



FORT PICKETT REGIONAL TRAINING INSTITUTE PHASE II

BLACKSTONE, VIRGINIA

SEPTEMBER 23, 2011

KENDALL MAHAN

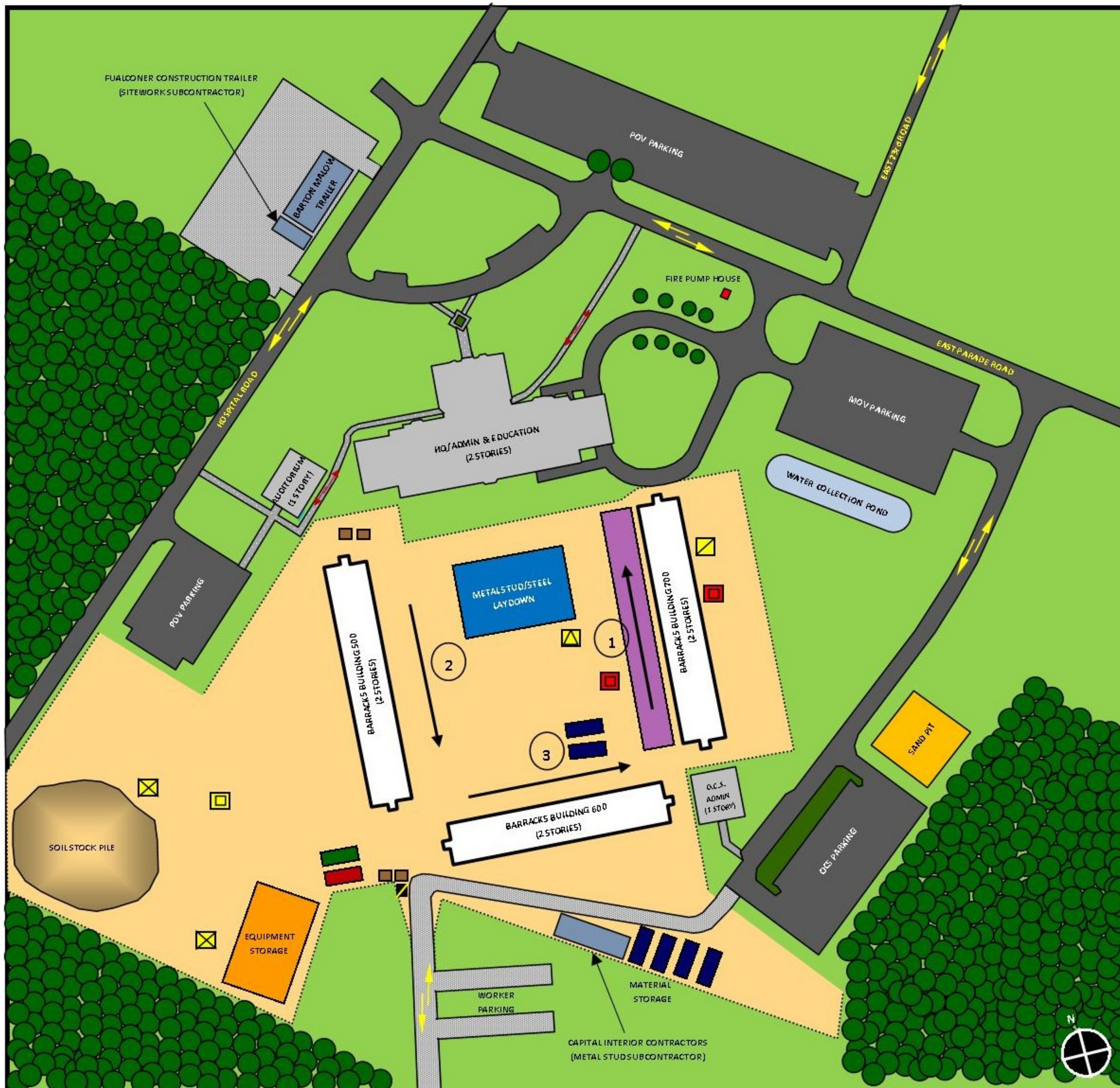
EXCAVATION PHASE SITE PLAN

SYMBOLS

- NEW BUILDINGS
- EXISTING BUILDINGS
- CONSTRUCTION TRAILERS
- PEDESTRIAN WALKWAY
- TEMPORARY PARKING/ROADS
- VEHICULAR TRAFFIC
- PEDESTRIAN TRAFFIC
- CONSTRUCTION FENCE
- RECYCLING CONTAINER
- WASTE CONTAINER
- PORTABLE TOILET
- TEMPORARY POWER
- MATERIAL STORAGE
- EQUIPMENT STORAGE
- EXCAVATOR
- DUMP TRUCK
- BACKHOE
- LULL
- FLOW OF CONSTRUCTION
- SEQUENCING #

Appendix C-3

Site Plan – Superstructure Phase



FORT PICKETT REGIONAL TRAINING INSTITUTE PHASE II

BLACKSTONE, VIRGINIA

SEPTEMBER 23, 2011

KENDALL MAHAN

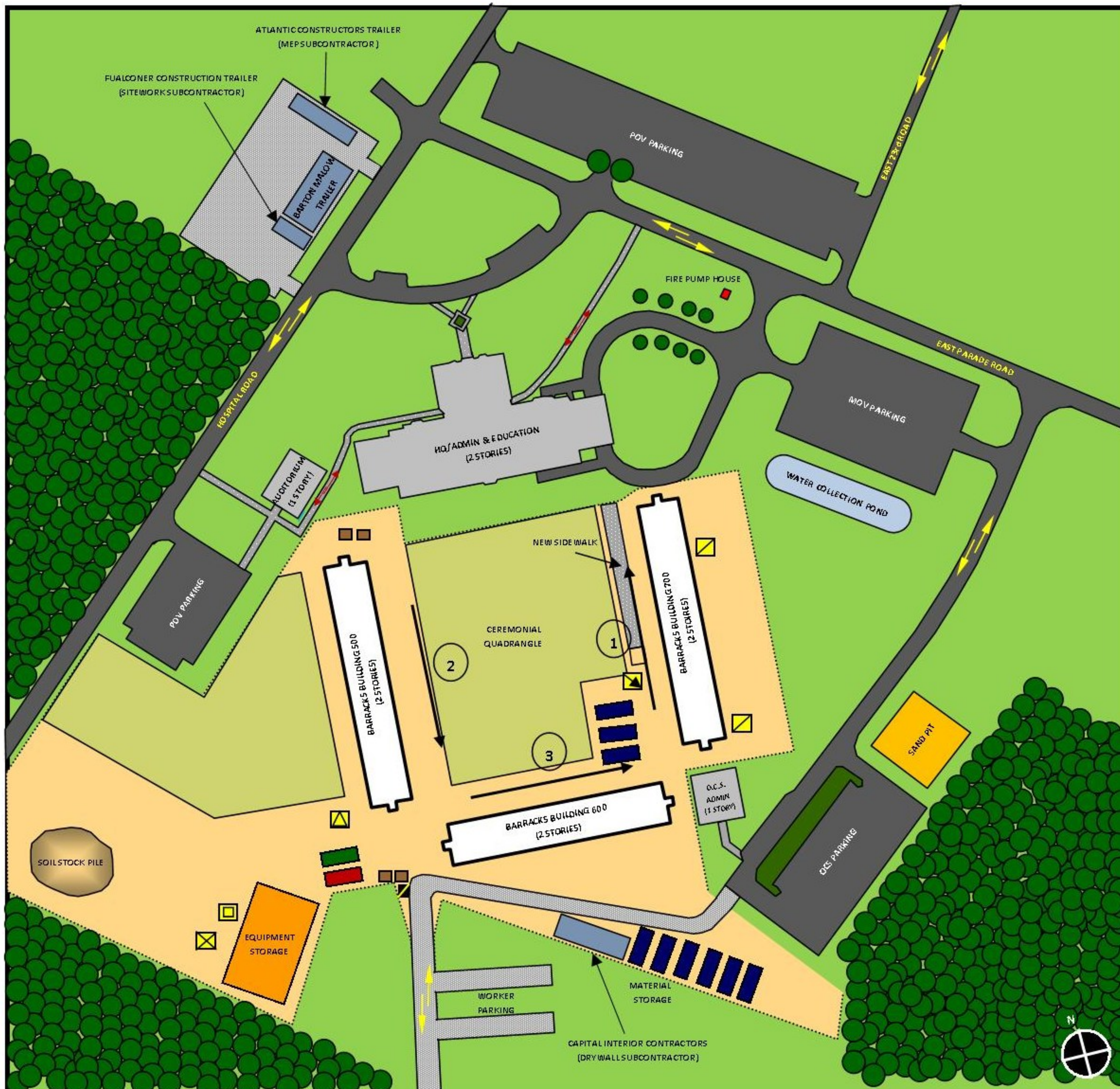
SUPERSTRUCTURE PHASE SITE PLAN

SYMBOLS

- NEW BUILDINGS
- EXISTING BUILDINGS
- CONSTRUCTION TRAILERS
- PEDESTRIAN WALKWAY
- TEMPORARY PARKING/ROADS
- VEHICULAR TRAFFIC
- PEDESTRIAN TRAFFIC
- CONSTRUCTION FENCE
- RECYCLING CONTAINER
- WASTE CONTAINER
- PORTABLE TOILET
- TEMPORARY POWER
- MATERIAL STORAGE
- EQUIPMENT STORAGE
- EXCAVATOR
- BACKHOE
- TELESCOPING LIFT
- LULL
- CRAWLER CRANE
- METAL STUD/STEEL LAYDOWN
- HOLLOW-CORE PLANK LAYDOWN
- FLOW OF CONTRUCTION
- SEQUENCING #

Appendix C-4

Site Plan – Finishes Phase



FORT PICKETT REGIONAL TRAINING INSTITUTE PHASE II

BLACKSTONE, VIRGINIA

SEPTEMBER 23, 2011

KENDALL MAHAN

FINISHES PHASE SITE PLAN

SYMBOLS

- NEW BUILDINGS
- EXISTING BUILDINGS
- CONSTRUCTION TRAILERS
- PEDESTRIAN WALKWAY
- TEMPORARY PARKING/ROADS
- VEHICULAR TRAFFIC
- PEDESTRIAN TRAFFIC
- CONSTRUCTION FENCE
- RECYCLING CONTAINER
- WASTE CONTAINER
- PORTABLE TOILET
- TEMPORARY POWER
- MATERIAL STORAGE
- EQUIPMENT STORAGE
- EXCAVATOR
- BACKHOE
- TELESCOPING LIFT
- LULL
- CONCRETE TRUCK
- NEW GRASS
- FLOW OF CONSTRUCTION
- SEQUENCING #