

AMBRIDGE

AREA HIGH SCHOOL



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AMBRIDGE, PENNSYLVANIA
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TECHNICAL ASSIGNMENT 1
OCTOBER 6, 2006

CONTENTS:

A.	EXECUTIVE SUMMARY.....	1
B.	PROJECT SCHEDULE SUMMARY	2-3
C.	BUILDING SYSTEMS SUMMARY.....	4-5
D.	PROJECT COST EVALUATION.....	6-9
E.	SITE PLAN OF EXISTING CONDITIONS.....	10
F.	LOCAL CONDITIONS	11
G.	CLIENT INFORMATION	11-12
H.	PROJECT DELIVERY SYSTEM	13-14
I.	STAFFING PLAN.....	15
J.	APPENDIX A – PROJECT SITE PLANS.....	A1-A2

EXECUTIVE SUMMARY

Through research for this technical assignment a wealth of knowledge about the Ambridge Area High School (AAHS) project was gathered. The purpose of this technical report is to evaluate the existing conditions and project delivery method. Included in the analysis is a project summary schedule, summary of the building systems, cost evaluation contrasting the actual costs versus RS Means and D4 Cost estimating methods. Next a detailed plan of the project site will further explain the means and methods used in site layout during construction, followed by descriptions of local conditions, project delivery method and staffing plan.

The new Ambridge Area High School was designed by Foreman Architects and Engineers. When opened, the 245,325 square foot, three story high school will replace a facility that is 80 years old. The Ambridge Area School District (AASD), the largest district in Beaver County, Pennsylvania chose new construction over renovation after many studies. Construction began on August 18, 2005 with substantial completion set for August 23, 2007, and students will occupy the building on January 5, 2008. Foreman Program & Construction Managers was chosen as the construction manager of the project and makes the high school the forth project in the district using The Foreman Group as a single source Architect, Engineer, and Construction Manager. The total project cost is just over \$42 million and will feature traditional classroom spaces, cafeteria, gymnasium, JROTC target range, and television studio. The Ambridge Area School District hopes the new high school will serve the district for many years to come.



PROJECT SCHEDULE SUMMARY

Listed general notes and progression of the project schedule as shown on next page.

General

- New AAHS site adjacent to existing school.
- Project site adjacent to major traffic routes in the town and the connection between State Route 65 and 51.
- Total road closure not possible
- Substantial completion cannot be delayed as the owner must take occupancy before the school year begins.
- Demolition of existing school to commence after occupancy of new building.

Foundation

- Drill and fill auger cast piles
- Excavate, form and reinforce grade beams
- Form, reinforce, and pour concrete wall on Northeast basement level face.

Structural

- Basement slab on grade leveled during erection but poured after topping out
- Steel erected using cranes within site fence with minimal closure of pedestrian walkways during erection

Facade

- CMU walls and brick veneer start at main building entrance and proceed around footprint in a counterclockwise fashion
- Window and curtain wall installation follows similar counterclockwise format

Finishes

- Finishes begin on ground level and proceed through subsequent floors as the slab on deck is poured
- Drywall installation begins after roof installation and building enclosure
- Ceiling installation begins when all above ceiling work is complete



BUILDING SYSTEMS SUMMARY

Yes	No	Work Scope	If yes, address these questions/issues
X		Demolition Required?	<ul style="list-style-type: none"> • Asbestos materials in existing school to be removed prior to demolition.
X		Structural Steel Frame	<ul style="list-style-type: none"> • Guy wires used as temporary bracing during erection • Crane used in several locations • Double angle shear connections and welds
X		Cast in Place Concrete	<ul style="list-style-type: none"> • Concrete placement via direct chute or pump for upper slabs • Slabs pours controlled by placing pour stops
X		Precast Concrete	<ul style="list-style-type: none"> • Precast used as window sills, band between first and second floor and decorative medallions and signs on building facade • Elements supported as part of masonry construction with incorporated flashing • Set by hand or mechanical lift
X		Mechanical System	<ul style="list-style-type: none"> • Ground floor mechanical room housing: <ul style="list-style-type: none"> - Controls - Three hot water boilers – 6560 MBH - Two 283 ton chillers - 18 rooftop AHU • Wet sprinkler system throughout entire building with 750 GPM fire pump
X		Electrical System	<ul style="list-style-type: none"> • Lighting 277/480, Receptacles 120/208. • 275 kW emergency diesel generator w/ ATS • Typical classroom lighting – 277V T5 54W • 13 transformers in building 480- 120/208V • 3 phase 4 wire
X		Masonry	<ul style="list-style-type: none"> • CMU exterior perimeter walls with face brick shell • Bricks tied to backup using brick ties and brick shelves • Red and Gray face brick used to reflect school colors • Steel scaffolding with 2x10 planks erected around building perimeter seven levels at highest point
X		Curtain Wall	<ul style="list-style-type: none"> • Curtain wall used in stairwell and entrance locations • Aluminum mullions with glass from ¼” to 1” in thickness. • Spandrel glass in areas between floor levels
X		Support of Excavation	<ul style="list-style-type: none"> • No dewatering needed • Trench boxes used on deep excavations

Table 1 – Building Systems Summary



Architecture:

The new Ambridge Area High School will replace the existing three story brick structure, built in 1928. Efforts to preserve and renovate the school failed when it was declared ineligible for the National Register of Historic Places. It stands as the most distinctive building in the town, also home to Old Economy Village, home of a nineteenth century Christian communal group, in the historic district which retains its original architecture. The new school will mimic the existing one with a massive red brick structure and a steel bridge entrance which pays homage to the steel fabrication operations which built the town in years prior. The new design was met with some resistance from the community, but the project goal is to provide the district with a more efficient building, aiming to improve indoor air quality, accessibility, and technology integration.

Facilities housed in the building include a state of the art computer aided drafting (CAD) suite, a television studio, one court gymnasium with retractable seating, cafeteria, and a JROTC target shooting range. A Large Group Instruction (LGI) space provides teachers with a flexible space capable of seating more students in a university lecture hall type setting.

Conveyance:

Conveyance in AAHS is provided by three elevators. One freight elevator with a capacity of 4,000 pounds travels two stops between the ground level storage space to the kitchen and food service area of the plan. Two passenger elevators on opposite sites of the building provide stops at all floors and a capacity of 2,500 pounds. Passenger elevators provide a method of transport for furnishings upon completion of the project as well as passengers to meet ADA compliance.



PROJECT COST EVALUATION

Several cost calculating methods were utilized to determine the construction cost of AAHS. First shown are the actual project costs as listed in table 3. Next, D4 estimating software was used to estimate the project cost as shown in table 4. Finally, RS Means Square Foot Cost Data was used to estimate construction cost. The table below shows the overall results of the two estimating methods as compared to actual project costs. D4 Cost achieved a cost closest to the actual cost of construction.

Total Building Cost				
	SF Cost	Size	Cost	% Difference
AAHS	\$158.35	245,325	\$38,846,057.00	0.00%
D4	\$154.20	245,325	\$37,829,115.00	2.62%
RS Means	\$100.10	245,325	\$24,557,032.50	36.78%

Table 2 - Estimating Method Comparison

Actual Cost Estimate:

AAHS Cost Schedule			
Package	Contract #	Total Cost (\$)	SF Cost (\$)
General Construction	401	\$14,933,500.00	
Cast Piles Construction	402	\$1,025,600.00	
Roofing Construction	403	\$1,194,500.00	
Aluminum Entrances and Storefronts	404	\$528,189.00	
Aluminum Windows	405	\$159,200.00	
Acoustical, Drywall & Plaster	406	\$3,869,686.00	
Ceramic and Quarry Tile	407	\$734,029.00	
Hardwood Flooring Construction	408	\$149,274.00	
Resilient Flooring and Carpeting	409	\$509,700.00	
Visual Display Boards	410	\$91,858.00	
Lockers Construction	411	\$156,600.00	
Food Service Equipment	412	\$509,159.00	
Vocational Shop Equipment	413	\$235,000.00	
Stage Equipment	414	\$193,377.00	
General Casework Construction	415	\$553,800.00	
Library Casework	416	\$102,800.00	
Science Casework Construction	417	\$247,700.00	
Audience Seating Construction	418	\$127,000.00	
Bleacher Construction	419	\$96,520.00	
Grandstands Construction	420	\$755,000.00	
Fire Protection Construction	422	\$453,400.00	
Plumbing Construction	423	\$1,895,000.00	
HVAC Construction	424	\$5,376,500.00	
Electrical Construction	425	\$3,837,000.00	
Communications Construction	426	\$1,111,665.00	
Contract Total:		\$38,846,057.00	\$158.35 / SF
AE FEE (Industry Range - 5-8%)	6.50%	\$2,524,994.00	10.29/SF
CM FEE (Industry Range - 2-5%)	3.50%	\$1,359,612.00	5.54/SF
Project Total:		\$42,730,663.00	174.18/SF

Table 3 - AAHS Actual Cost Schedule

D4Cost 2002 Estimate:

D4 Cost estimating software was utilized to provide a basis of comparison for the Ambridge Area High School. Aberdeen High School was selected for comparison because of several criteria, including floor count, building type and building size (SF). Aberdeen, at 206,442 SF falls just under Ambridge at 245,325 SF. Ambridge's total building square foot cost of \$158.35 falls just over Aberdeen's cost of \$154.20/SF. This difference of 2.62% can be attributed to the five year difference in time of construction as well as fluctuations in material costs including steel, concrete, and building metals such as copper.

Aberdeen High School - Jul 2001 - MD- Aberdeen				
	No. of Floors			3
	No. of Buildings			1
	Project Height			46.8
	1st Floor Height			14.8
	1st Floor Size			147,095
	Building Sq. Size			206,442
Division		Percent	Sq. Cost	Amount
01	General Requirements	13.78%	\$21.25	\$4,387,362
03	Concrete	4.42%	\$6.82	\$1,408,377
04	Masonry	9.32%	\$14.38	\$2,968,020
05	Metals	9.68%	\$14.93	\$3,081,621
06	Wood, Plastics, and Composites	1.85%	\$2.85	\$587,500
07	Thermal and Moisture Protection	4.33%	\$6.67	\$1,377,342
08	Openings	7.90%	\$12.18	\$2,514,428
09	Finishes	6.48%	\$10.00	\$2,063,423
10	Specialties	1.78%	\$2.74	\$565,763
11	Equipment	1.96%	\$3.02	\$624,358
12	Furnishings	3.30%	\$5.09	\$1,049,773
14	Conveying Systems	0.31%	\$0.48	\$99,000
15	Mechanical	23.38%	\$36.05	\$7,441,644
16	Electrical	11.51%	\$17.75	\$3,664,000
	Total Building Cost		\$154.20	\$31,832,611

Table 4 - D4 Cost Estimate of Aberdeen High School

RS Means Estimate:

When referencing RS Means, the size of Ambridge Area High School falls just above the upper size boundary of 210,000 square feet. A building with a structural steel frame, face brick and CMU backup amounts to \$100.10 / square foot. AAHS being nearly 15% larger in size is not adequately estimated using this method. Also Means calculates costs for a 2 story building and does not account for equipment such as gymnasium bleachers, auditorium seating or kitchen equipment. The location adjustment factor for Pittsburgh, Pennsylvania is 99.9 and therefore is ignored in this estimate. The AAHS was bid in 2005 and using RS Means 2005 cost data requires no time adjustment factor.


Institutional		2005 Costs for Pittsburgh, PA (150)								
School, High, 2-3 Story		Union								
		Costs in \$ per Square Foot of gross floor area calculated for a 2 story building with 12' story height.								
		Face Brick with Concrete Block Back-up								
		Steel Frame								
Exterior Wall Type	S.F. Area	50000	70000	90000	110000	130000	150000	170000	190000	210000
& Structural System	L.F. Perimeter	816	1083	1100	1300	1390	1450	1433	1566	1700
Face Brick with Concrete Block Back-up	Steel Frame	115.43	112.39	107.29	106.14	104.20	102.70	100.90	100.40	100.10
	R/Conc. Frame	118.68	115.83	110.84	109.74	107.94	106.39	104.65	104.20	103.50
Decorative Concrete Block	Steel Frame	111.24	108.59	104.30	103.30	101.70	100.40	98.90	98.45	98.20
	R/Conc. Frame	115.28	112.64	108.34	107.34	105.74	104.45	102.95	102.50	102.25
Limestone with Concrete Block Back-up	Steel Frame	124.13	120.73	113.89	112.59	110.14	107.99	105.54	104.99	104.55
	R/Conc. Frame	128.82	125.47	118.63	117.33	114.84	112.69	110.29	109.69	109.29

Figure 2 - RS Means Square Foot Cost Data

Using the value of \$100.10/SF as shown in R.S. Means for the AAHS project size indicates a construction cost of \$24,557,032.00.

R.S. Means Projected Building Cost			
	SF Cost	Size	Cost
RS Means	\$100.10	245,325	\$24,557,032.50

Table 5 - RS Means Projected Cost

SITE PLAN OF EXISTING CONDITIONS

Ambridge is situated along the Ohio River, sixteen miles Southwest of Pittsburgh, PA. The project site sits adjacent to Duss Avenue (SR 989) and 11th Street, both major traffic routes in the town and the connection between State Route 65 and 51 as shown in the following vicinity maps. For the project specific site plan please refer to Appendix A.

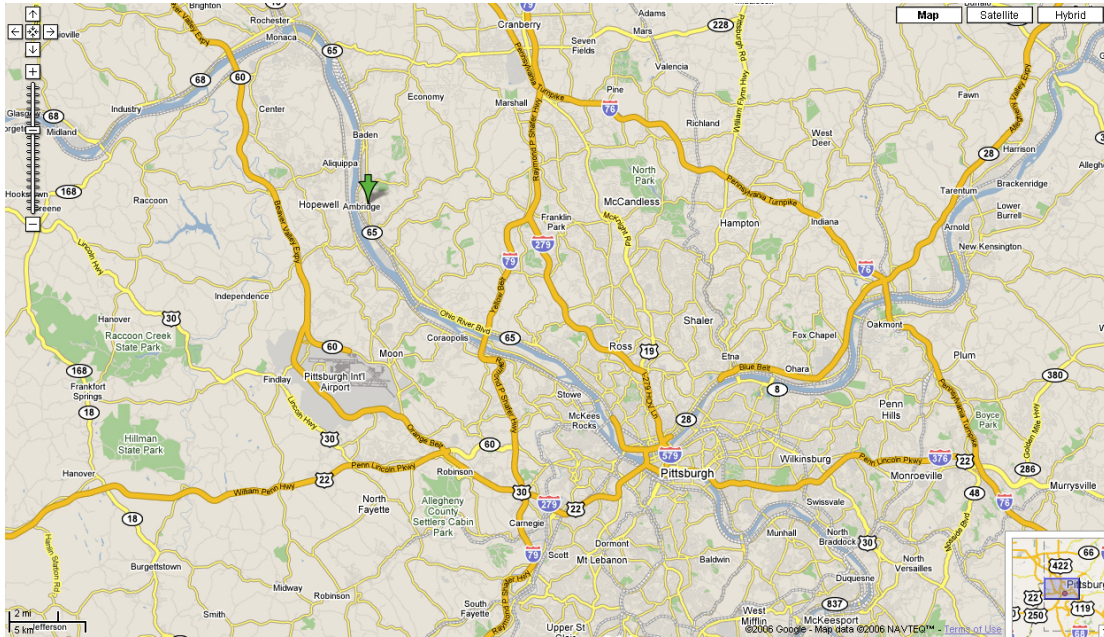


Figure 3 - City of Pittsburgh Vicinity Map



Figure 4 - Town of Ambridge Vicinity Map



LOCAL CONDITIONS

Design and construction on Ambridge Area High School were typical of school construction in southwest Pennsylvania. Construction methods in the Pittsburgh area mostly consist of a structural steel frame with slab on deck floors, as does AAHS. The availability of steel and concrete in the area is abundant with several concrete plants in the vicinity. The soil in the project area usually consisted of a level of fill material, usually less than ten feet in depth, followed by layers of siltstone and clay. As Ambridge borders the Ohio River, these soil types are to be expected. Soil was adequate for excavations but forced the use of multiple auger cast piles with pile caps and grade beams to attain proper bearing capacity.

Parking during construction was provided for management personnel in a gravel lot adjacent to the contractor trailers, and accessed from the lower entrance on 11th street (See site plan). Overflow parking was provided on neighboring streets and a park and ride lot within walking distance of the site. Dumpster tipping fees averaged between \$400 and \$500 with steel waste from construction being recycled, and other waste sent to a landfill.

CLIENT INFORMATION

History

Ambridge, Pennsylvania was incorporated in 1910, named after the American Bridge Company, which started operations there in 1903. Ambridge is situated along the Ohio River, sixteen miles Southwest of Pittsburgh, PA. The population of the town peaked during WWII and has seen a consistent decline since American Bridge ceased operations in 1983. Enrollment of AAHS and the AASD has seen a decline years since. The school's mascot is the Bridger, saluting the industrial heritage of the town.

With enrollment on the decline, the AASD chose to consolidate from five elementary schools in the district to three, choosing to either renovate or build, to provide a lower cost alternative to operating from five aging buildings. The new Ambridge Area High School (AAHS) is the newest school to be built in the Ambridge Area School District (AASD). State Street Elementary, finished in August 2001, underwent an extensive renovation and expansion. Economy Elementary and Highland Elementary were new construction and opened in August 2002 and 2004 respectively.

Owner Satisfaction

Since the AAHS is the fourth construction project in the district in five years, much thought has been placed as to what the expectations of the owner are. In addition to providing a building to serve the community for decades, the project has to also stay within an inflexible budget and schedule. With the design, engineering, project management, and some contractors playing a role in all four district projects, time was saved in adjusting to the acclimation period in dealing with a particular owner. With most parties familiar with the policies and expectations of the AASD quality could be increased without an increase in input of the team. The construction management agency was a critical step in ensuring the needs of the owner were fulfilled, aiding to minimize change orders and increase overall construction quality. The project schedule was inflexible with substantial completion coming just under four months before



occupancy, time allotted for the installation of classroom furnishings and equipment being moved from the existing school set to open doors to students in January 2008.



PROJECT DELIVERY SYSTEM

Construction of the new Ambridge Area High School utilized the design-bid-build delivery system with Foreman Architects Engineers (FAE) as the design team, then bid and built using multiple prime contracts to conform to Section 7-751 of the Pennsylvania School Code of 1949, specifying school building projects must have at least four prime contracts: General, Plumbing, HVAC, and Electrical. The Ambridge Area High School used twenty five prime contracts.

- | | |
|-------------------------------------|--------------------------------------|
| 1. General Construction | Kusevich Contracting Inc. |
| 2. Cast Piles Construction | Berkel & Company Contractors Inc. |
| 3. Roofing Construction | G & W Roofing & Construction Inc. |
| 4. Aluminum Entrances/Storefronts | Don's Glass & Mirror |
| 5. Aluminum Windows | Specified Systems Inc. |
| 6. Acoustical, Drywall & Plaster | J.J. Morris & Sons |
| 7. Ceramic and Quarry Tile | J.P. Phillips Inc. |
| 8. Hardwood Flooring Construction | Wood Floor Designs |
| 9. Resilient Flooring and Carpeting | Degol Carpet |
| 10. Visual Display Boards | Polyvision Inc. |
| 11. Lockers Construction | Lyon Workspace Products |
| 12. Food Service Equipment | Gateway Kitchen Equipment & Supplies |
| 13. Vocational Shop Equipment | Allegheny Educational Systems Inc. |
| 14. Stage Equipment | Pittsburgh Stage Inc. |
| 15. General Casework Construction | Northeast Interior Systems Inc. |
| 16. Library Casework | T.F. Nichols Company |
| 17. Science Casework Construction | Fisher Hamilton LLC |
| 18. Audience Seating Construction | Naffei Strayer Furnishings Inc. |
| 19. Bleacher Construction | Dave York Sports Inc. |
| 20. Grandstands Construction | Dave York Sports Inc. |
| 21. Fire Protection Construction | Vrabel Plumbing Co. LLC |
| 22. Plumbing Construction | Vrabel Plumbing Co. LLC |
| 23. HVAC Construction | Wayne Crouse Inc. |
| 24. Electrical Construction | R.E. Yates Electric Inc. |
| 25. Communications Construction | Morocco Electric Inc. |

The Ambridge Area School District (AASD) chose Foreman Program and Construction Managers (FPCM) as a construction management agency, to provide on site management and a one point contract between the project and the AASD. Foreman has completed several previous projects in the district including the renovation and expansion of an existing elementary school and the new construction of two elementary schools.

The Foreman Group, taking roles as Architect, Engineer, and Construction Manager on this project provide a single source entity taking the project from conceptual design to finished construction without changing hands. This method helps to ensure constructability issues are considered and handled accordingly in design to reduce potential problems in the field.



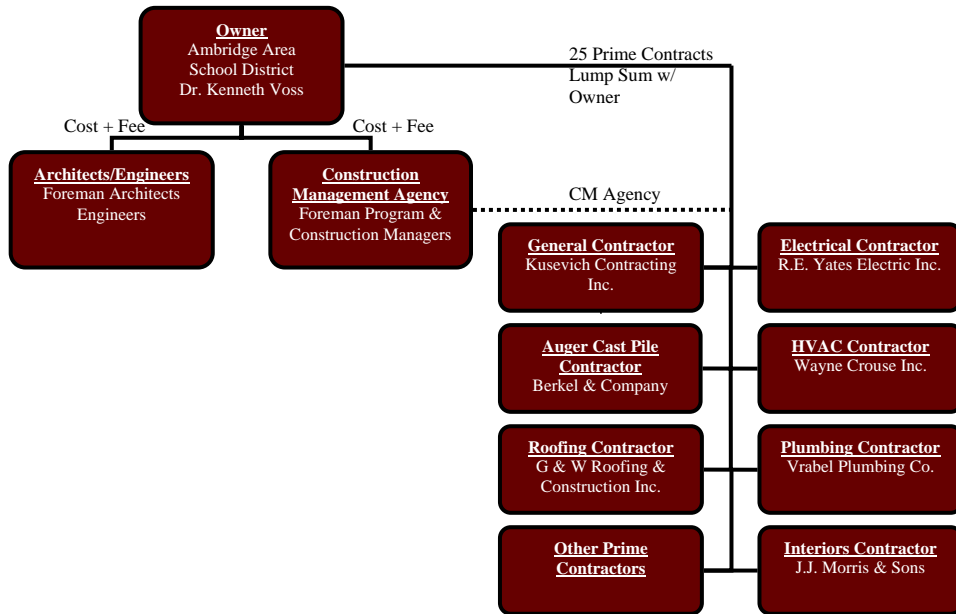


Figure 5 - AAHS Organizational Chart

STAFFING PLAN

The construction management agency on the Ambridge Area High School organized their operations staff in three levels. At the top level, the Project Executive, spending just four to eight hours per month provided general oversight of the project. The next tier includes the Project Manager, whose part time duties include schedule management, cost tracking, negotiating changes, and correspondence with the owner. Lastly, two full time Site Managers provided on site construction coordination and planning, maintaining and updating the schedule, and safety management.

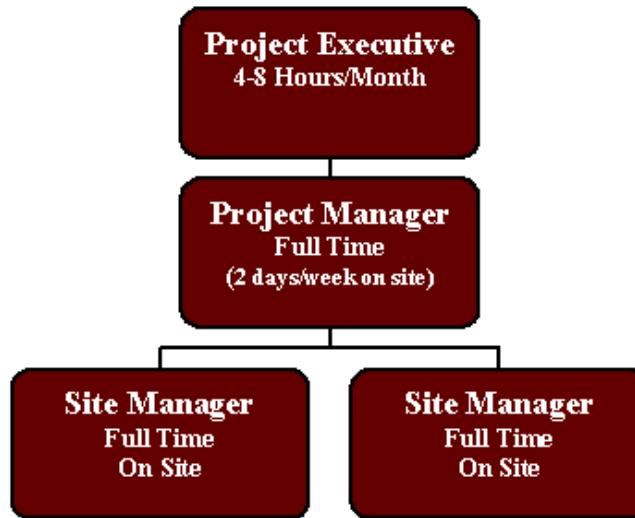
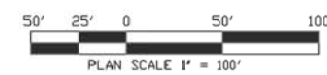
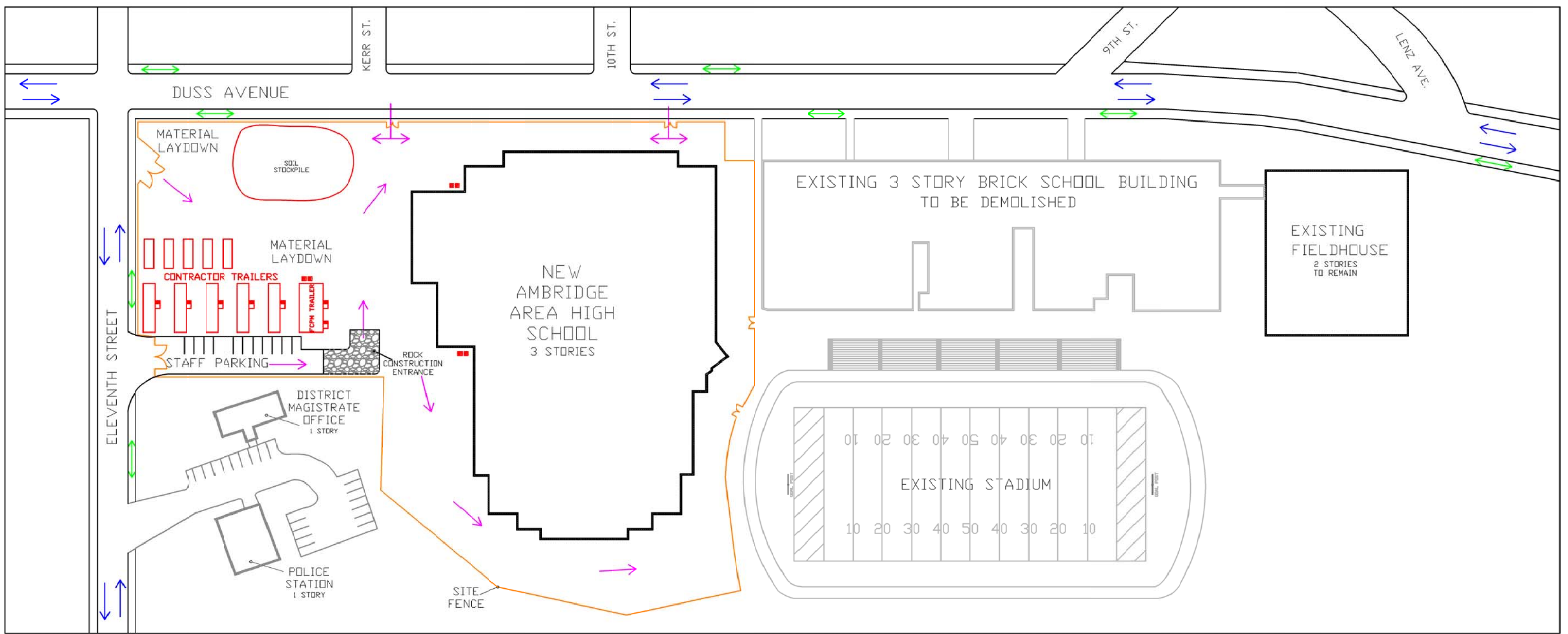


Figure 6 - FPCM Staffing Chart for AAHS



**APPENDIX A
PROJECT SPECIFIC SITE PLANS**

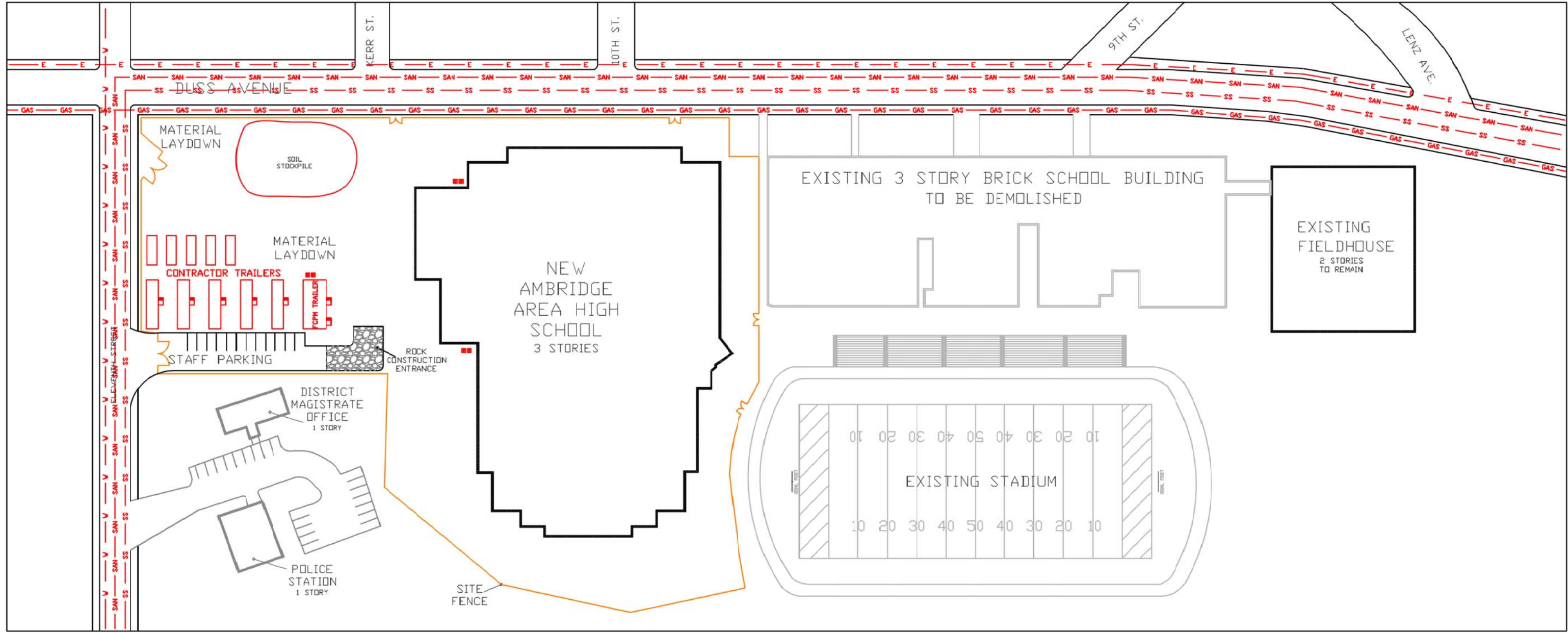


- RESTROOM
- PEDESTRIAN FLOW
- TRAFFIC FLOW
- MATERIAL FLOW

DRAWN BY
BRANDON MCKEE

PROJECT
AMBRIDGE AREA
HIGH SCHOOL
AMBRIDGE
PENNSYLVANIA

DRAWING #
C-100
SITE PLAN



UNDERGROUND UTILITIES		DRAWN BY BRANDON MCKEE
	ELECTRIC	PROJECT AMBRIDGE AREA HIGH SCHOOL AMBRIDGE PENNSYLVANIA DRAWING # C-101 UTILITY SITE PLAN
	WATER	
	NATURAL GAS	
	SANITARY SEWER	
	STORM SEWER	