Technical Assignment One

Penn State AE Senior Thesis

Image courtesy of U.S. Army Corps of Engineers

Advanced Individual Training

A.I.T. Barracks

Fort Eustis, VA

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Construction Management

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September 23, 2011

Executive Summary

The Advanced Individual Training (A.I.T.) Barracks is a three story building with a progressive collapse avoidance structural system. The owner of the building is the U.S. Army Corps of Engineers. The building envelope has precast accents and a brick veneer (non load bearing) façade. A.I.T plans to house a total of 300 soldiers in 150 sleeping modules. This 91,800 S.F. building will cost approximately 18,166,185 dollars when the project is finished in February of 2012. The building has many unique features not present in a normal Barracks i.e. the building lacks an elevator. Although the building has many unique features no unusual techniques were implemented. LEED Silver is the current goal of the project, the project is projected to successfully achieve it.

Technical assignment one will give information regarding my building, how it was constructed and the scope of work. This report includes an executive summary, project schedule summary, building systems summary, project cost evaluation, existing conditions, site layout planning, local conditions, client information, project delivery system, and a staffing plan.

After reviewing the construction schedule, contractual arrangements, and budget some questions have arisen regarding my thesis research. The construction schedule and budget poses many questions as it is a very fast track schedule. Any new activities will hinder the schedule and push back the finish date if not correctly executed. The owner is very adamant on finishing the project on time, it will be interesting to see if the project is completed on time using the current projected schedule. It does not seem that the contractual arrangements will pose any questions as the project delivery system is a fairly simple hierarchy with Lump Sum contracts.

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Project Schedule Summary

See Appendix A for 11”x17” one-page Project Schedule Summary

A.I.T. Barracks

ID	Task Mode	Task Name	Duration	Start	Finish
1		NTP	0 days	Thu 10/14/10	Thu 10/14/10
2		Obtain Right to Entry	0 days	Wed 1/26/11	Wed 1/26/11
3		Design Phase	81 days	Thu 10/14/10	Thu 2/3/11
4		Bid and Award Phase	125 days	Mon 11/29/10	Fri 5/20/11
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10		Earthwork	212 days	Thu 1/20/11	Fri 11/11/11
11		Foundations	50 days	Fri 3/11/11	Thu 5/19/11
12		Structure	163 days	Tue 5/10/11	Thu 12/22/11
13		Final Design Documents Avaiable	0 days	Wed 5/18/11	Wed 5/18/11
14		Building Envelope	68 days	Fri 7/29/11	Tue 11/1/11
15		MEP Rough in (Inwall)	118 days	Mon 6/13/11	Wed 11/23/11
16		MEP Rough in (Overhead)	84 days	Wed 8/3/11	Mon 11/28/11
17		Interior Finishes	137 days	Thu 7/14/11	Fri 1/20/12
18		MEP Finishes	76 days	Fri 8/19/11	Fri 12/2/11
19		Punchlist	56 days	Fri 12/2/11	Fri 2/17/12
20		Quality Control Testing Complete	0 days	Wed 1/11/12	Wed 1/11/12
21		Project Substantial Completion	0 days	Fri 2/17/12	Fri 2/17/12

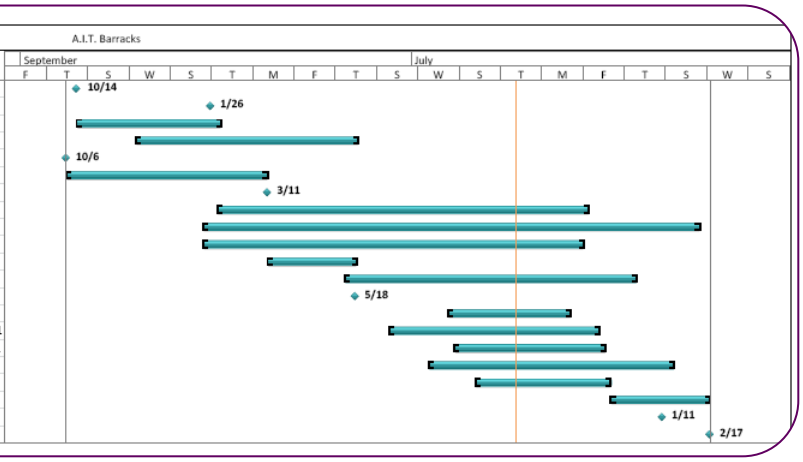


Fig 1. Project Schedule Summary

The entire schedule of the project is projected to take 462 calendar days after the notice to proceed is received. The foundations phase will take approximately 50 days. Within this time frame aggregate piers will be rammed for installation, foundation walls will be formed, reinforced with rebar, and poured, and the slab on grade will be installed with a vapor barrier and mesh. The Structure phase will take approximately 163 days. This phase consist of framing each floor of the three story building with steel walls, beams, and columns. The interior finishes will take approximately 137 days. These finishes include drywall, paint, window blinds, display cases and much more. In all the key phasing stages each step is inspected before the next step can continue. On this project safety is very important and this is just one more precaution that is necessary.

Building Systems Summary

Yes	No	Work Scope	If yes, Address these questions/ issues
	X	Demolition	Types of Materials, lead paint, or asbestos?
X		Structural Steel Frame	Type of bracing, composite slab?, crane size/ type/ location (s)
X		Cast in Place Concrete	Horiz. And Vert. Formwork types, concrete placement methods
X		Precast Concrete	Casting location, connection methods, crane size/type/location (s)
X		Electrical System	Size/Capacity, redundancy
X		Mechanical System	Mech. Room locations, system type, types of distribution systems, types of fire suppression
X		Plumbing System	Type of systems
X		Fire Alarm and Mass Notification System	Types of fire suppression
X		Sprinkler System	types of fire suppression
X		Masonry	Load bearing or veneer, connection details, scaffolding
	X	Curtain Wall	Materials included, construction methods, design responsibility
	X	Support of Excavation	Type of excavation support system, dewatering system, permanent vs. temporary

Building Systems Summary

Structural Steel Frame:

The barracks building is 3 stories in height and therefore must be designed in accordance with requirements for progressive collapse avoidance. In general the building shall be designed such that the vertical load carrying elements of the structure are not exposed to the exterior of the building. The structural steel frame is to be pre-engineered in panels and set in place. Temporary shoring and bracing is to be used as bracing support. The light gauge subcontractor provided their own crane, a 50 ton crane. No tower crane or a large mobile crane was necessary as nothing hoisted was heavy enough to require it.

Cast in Place Concrete:

The cast in place concrete slabs are located on each of the 3 stories. The slabs are horizontally formed with welded metal angles to be left in place. Concrete thickness is designed to be 6 inches and the concrete strength shall be 4000 psi after 28 days. The percent of steel reinforcement required is 0.1 (Wire size No. 6x6 W4), placed at 2.5 inches depth from top. A 4 inch gravel base and vapor barrier are also mandatory. The concrete placement method of the concrete will be done with a concrete pump truck rented by the subcontractor.

Precast Concrete:

The building will not have any precast panels, only precast accents. These accents will not require an on site crane. The precast accents such as sills, lentils, and medallions will be casted off site. Each accent will be connected to the building in a different way. For example the precast concrete sill shown in figure 2 is supported by a steel angle. This steel angle then connects to the building.

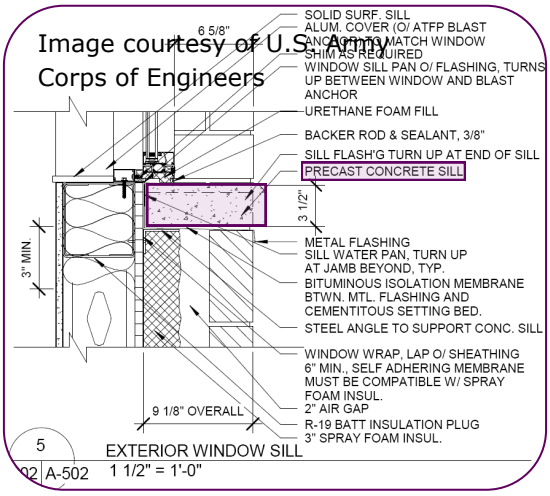


Fig 2. Exterior Window Sill detail

Building Systems Summary

Electrical Systems:

The electrical system consists of a main 480/277 volt, 1600 amp service which enters the main electrical room switchboard. The service feeds 277/480 volt lighting and mechanical equipment throughout the building is also transformed to 120/208 volt to feed receptacles and other loads in the building. Emergency batteries in the fluorescent light fixtures and exit signs provide life safety egress lighting. Other systems included in the building are a data/communication and door monitoring system.

HVAC Systems:

The facility will be ventilated using two dedicated outdoor air units that supply neutral air (approximately 70 deg F) to each occupied space. These units have a total energy recovery wheel to recover energy from the building exhaust air. A 160 ton air cooled chiller and a 30 ton DX condensing unit will provide the cooling for the facility. Two gas fired boilers located in the first floor mechanical room will provide the hot water for building heating. Four pipe fan coil units (hot water and chilled water) located in each occupied space will provide space heating or cooling.

Image courtesy of U.S. Army Corps of Engineers

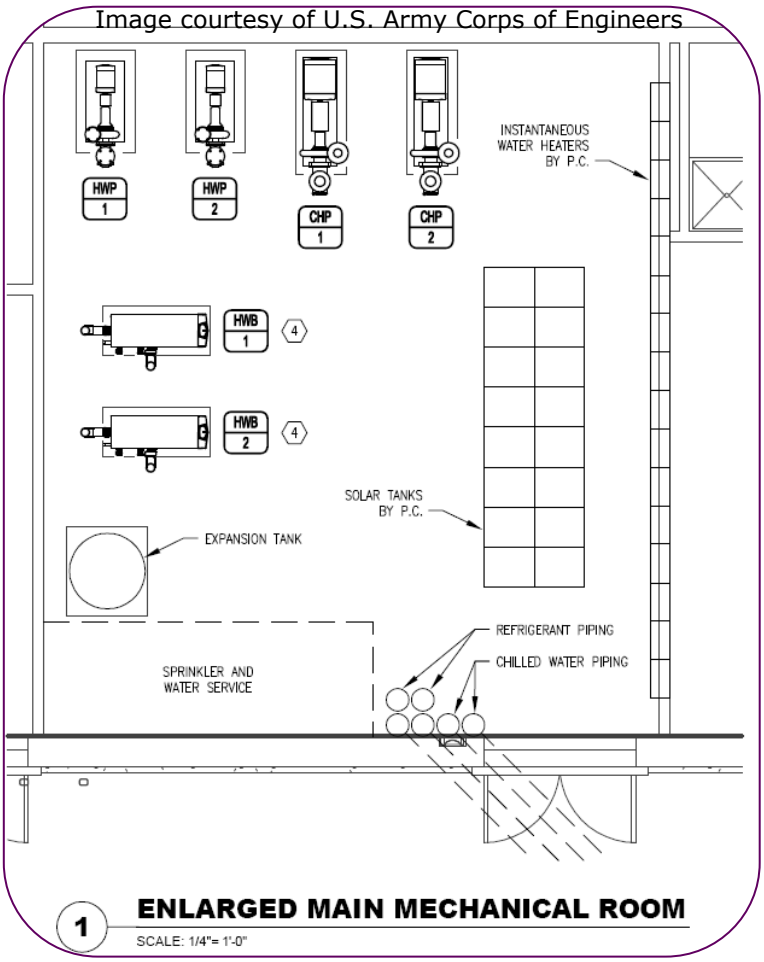


Fig 3. Enlarged Main Mechanical Room

Building Systems Summary

Plumbing Systems

The plumbing systems will consist of sanitary and vent, domestic cold and hot water, and natural gas. The domestic hot water will be a solar heating system being supplemented with gas-fired instantaneous water heaters. The laundry and scrub rooms will have interceptors prior to entering the sanitary system. The domestic water will be routed on the first floor and extend vertically to the second and third floors though chases, where the piping connection between floors will be protected with intumescent fire collars. The natural gas system is only in the first floor mechanical room.

Fire Alarm and Mass Notification System:

A combination Fire Alarm/Mass Notification System will be provided for the building. The system will include manual and automatic detection devices located per code requirements, including automatic spot-type smoke detectors in each sleeping unit. The smoke detector located in the sleeping unit will sound a local alarm only and will send a supervisory signal to the building fire alarm control panel; these detectors will not initiate total building alarm. All initiation devices are designed to be installed on a Class A signaling line circuit. The system includes notification devices located per code requirements. All auditable notification devices will be speakers shared for both fire alarm and mass notification purposes. The Fire Alarm/Mass Notification System will communicate with the Base Wide Mass Notification System via a Monaco BTXM-4 Transceiver.

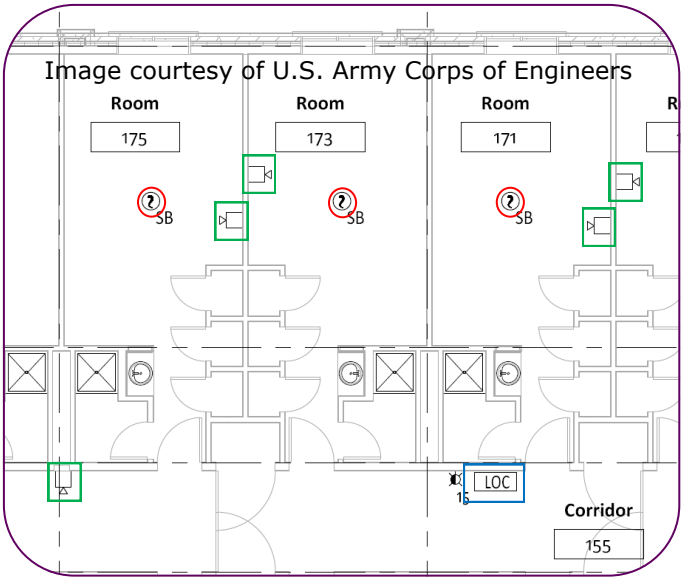


Fig 4. Typical Room: Spot-type smoke detector (red), Speaker wall mounted (green), and Local Operating Console (blue)

Building Systems Summary

Sprinkler System:

The building will be protected throughout with a sprinkler system. The attic is considered a noncombustible concealed space and will not be provided with sprinklers. The system pressure will be provided by the local water supply; fire pumps are not required to boost system pressure. The building has one fires department connection located in the exterior wall of the building and within 150’ of a fire hydrant. The sprinkler system water flow and tamper switches will be monitored by the fire alarm system.

Masonry:

The building has a masonry veneer, none load bearing. It is connected to the building with dovetail anchors. The dovetail anchors are the flexible wire type, 3/16 inch diameter zinc-coated steel wire, triangular shaped, and attached to a 12 gauge or heavier steel dovetail section. Figure 5 highlights the 3-5/8” brick veneer. The type of scaffolding used was a hydraulic lift more specifically, Fraco Mast Climbers.

LEED:

A.I.T is on track to be LEED Silver. Currently the project total (pre-certification estimate) is 52 points which is in the range of LEED silver 50 to 59 points. To achieve this status a very sustainable site, high water efficiency, and a high content of recycled materials and resources will be implemented.

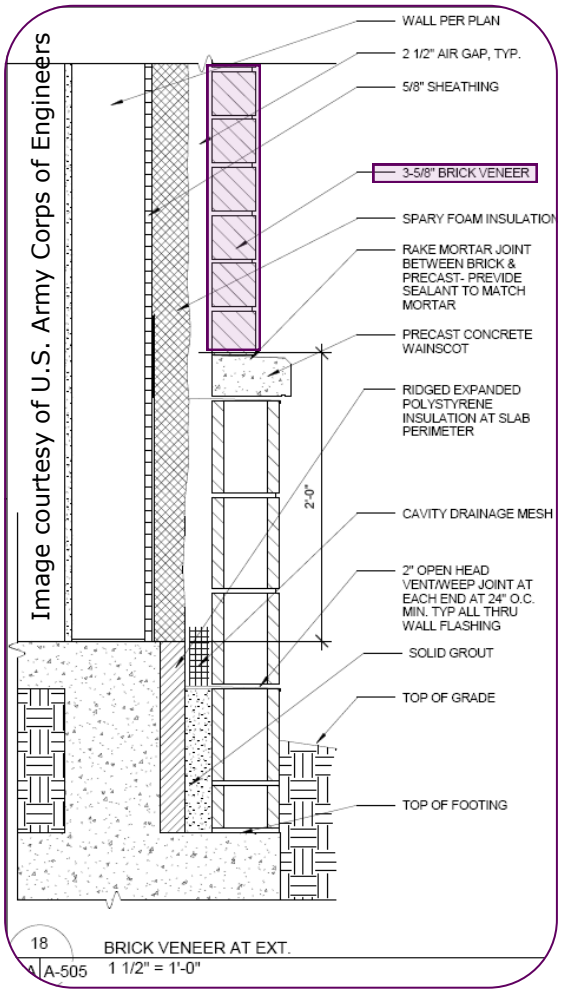


Fig 5. Brick Veneer at EXT detail

Project Cost Evaluation

Actual Building Construction Cost: $ 16,411,074.00

Construction Cost per SQft: $ 178.77

Total Project Costs: $ 18,166,185

Total Cost per SQft: $ 197.89

Major Building Systems		
System Description	Cost	Cost/SQft
Earthwork	$ 1,134,497	$ 12.35
Cold Formed Metal Frame	$ 1,380,200	$ 15.03
Metal Support System	$ 1,677,140	$ 18.27
Mechanical	$ 3,534,700	$ 38.50
Fire Protection	$ 144,900	$ 1.58
Electrical	$ 1,816,550	$ 19.79

RS Means Cost per SQft: $ 131.92

It is assumed that the RS Means data has no Mechanical information added to price and Major Building Systems data was used to adjust.

Adjusted RS Means Cost per SQft: $ 170.42

RS Means Adjusted to add Mechanical information.

Project Cost Evaluation

Mechanical System				
		Cost Per S.F.		
Description	RS Means Description	MAT.	INST.	Total
160 Ton air cooled chiller	Chilled water, Air Cooled Condenser System Apartment Coorridors, 80,000 S.F. 146.66TON	4.17	3.51	7.68
30 Ton DX condensing unit	Split system, air cooled condensing unit, Apartment Coorridors, 20,000 S.F. 36.66 Ton	2.65	3.33	5.98
Dedicated outdoor air unit with energy recovery wheel	Self-contained, Air cooled Unit systems, Apartment corridors, 10,000 S.F. 18.33 TON	3.31	3.07	6.38
	Readjustment for S.F.	6.62	6.14	12.76
	Total cost per S.F.	13.44	12.98	26.42
	Total Cost (91,800 S.F.)	$2,425,356		
Two 700 m,b.h. output boilers	Boilers, Hot water & Steam, Gas, cast iron, hot water, 544 m.b.h.	$14,250 each		
	Total cost of boilers (2)	$28,500		
Four pipe fan coil units (hot water and chilled water)	Heating/Cooling System, gas fired, SEER 14, 2000 SF Bldg	$10,975 each		
	Total cost of fan coil units (4)	$43,900		
	Readjustment for S.F. (91,800)	$175,600		
	Total Mechanical System Cost	$2,629,456		

Project Cost Evaluation

Plumbing System		
Description	RS Means Description	Cost Each
Domestic Hot water with a solar heating system	Solar, Closed Loop, Hot water system, 1/2" tubing, 4 ea 4' x4'-4" vacuum tube collector, 80 gal. tank	$12,475 each
151 Bathrooms	Three Fixture Bathroom, Two wall plumbing, Water closet, stall shower, & lavatory	$5,600 each
	Readjustment for 151 bathrooms	$845,600
	Total Plumbing System Cost	$858,075

Electrical System		
Description	RS Means Description	Cost Each
480/277 volt, 1600 amp service	Electric Service, 3 have - 4 wire, 277/480 volt	$45,500 each
482 Light Fixtures	Fluorescent fixtures, T8 energy saver 32 Watt lamps, 1.6 watt per S.F., 40 FC, 10 fixtures @32 watt per 1000 S.F.	$471,852
1439 Receptacles	Receptacles & Switches by Each, Receptacle duplex 120 V, 20A	$255 each
	Readjustment for 1439 Recptacles	$366,945
	Total Electrical System Cost	$884,297

Project Cost Evaluation

Fire Protection System		
Description	RS Means Description	Cost Each
Automatic Sprinklers	Wet pipe sprinkler systems, steel, back, sch. 40 pipe, light hazard, one floor 20000 S.F.	$131,400
	Total Sprinkler System Cost	$131,400

Total MEPF System Cost	$4,503,228

When comparing the differences between the CC square foot estimate and RS means estimate there was found to be a 5% difference *after the mechanical system was added to the RS means data*. This small difference could be due to unforeseen conditions that RS means is unaware of and does not take into consideration.

When comparing the difference between the actual MEPF estimate and MEPF Assemblies estimate. The mechanical system was found to have a difference of 26%. This large difference could be due to the face that the assemblies estimate only considers large equipment. In the project cost report the plumbing system was not explicitly broken down so the plumbing system can not be compared at this time. The electrical system was found to have a difference of 51%. The difference is very significant major electrical systems were calculated, but because this was not a detailed estimate a lot of critical information could have not been included. For example the amount of wire was not taken into consideration in this estimate. The difference found when estimating the fire protection system was 9%. This difference could be due to the fact that the S.F. is approximate in the assembles estimate.

Existing Conditions

See Appendix D For 11”x17” Existing Conditions Plan

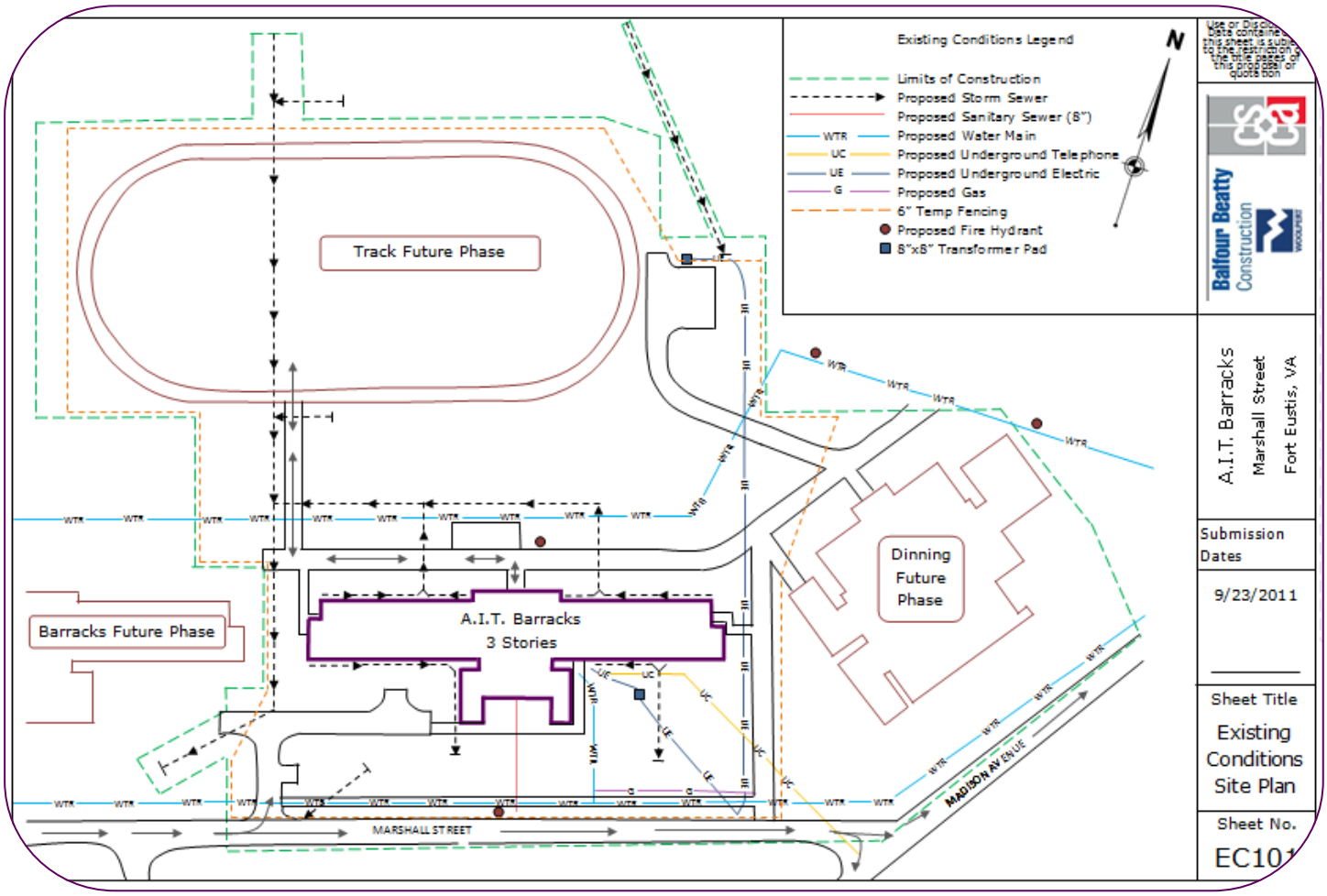


Fig 6. Existing Conditions Site Plan

The A.I.T. Barracks site is a site with many future buildings. These future buildings are still very much in the design phase and building heights are not available for posting. Pedestrian patterns are limited to direct paths to only necessary locations as shown in gray.

Site Layout Planning

See Appendix E For 11”x17” Phase 1 Foundations Site Plan

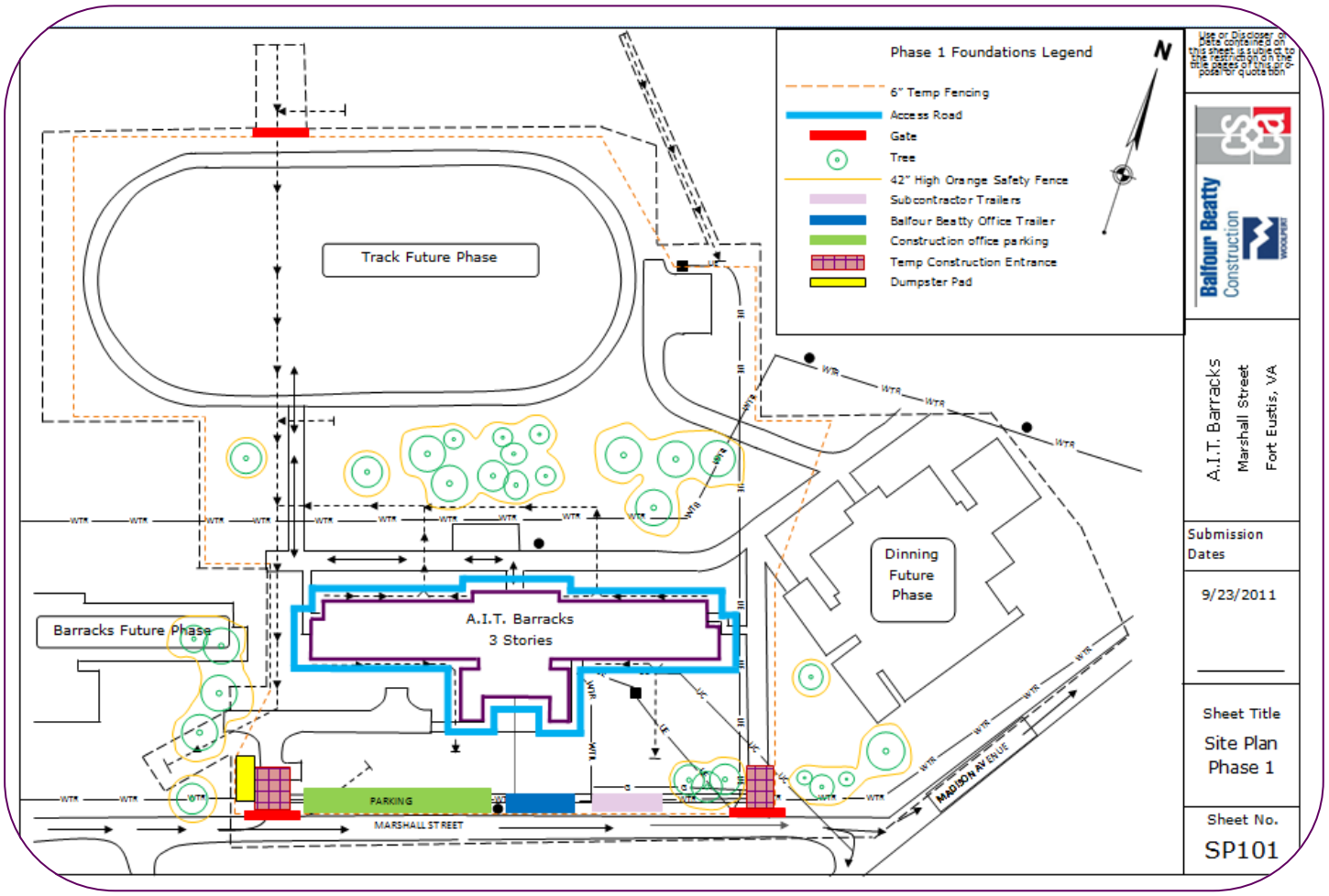


Fig 7. Phase 1 Foundations

No demolition or excavation was needed for this project making phase 1 foundations. During this phase the temporary construction entrance and gates were established. These key features were necessary for the concrete trucks to access the site to pour the foundations. An access road is located around the site for easy access for all staff. When critiquing the layout it is found to be very effective and accessible.

Site Layout Planning

See Appendix E For 11”x17” Phase 2 Superstructure Site Plan

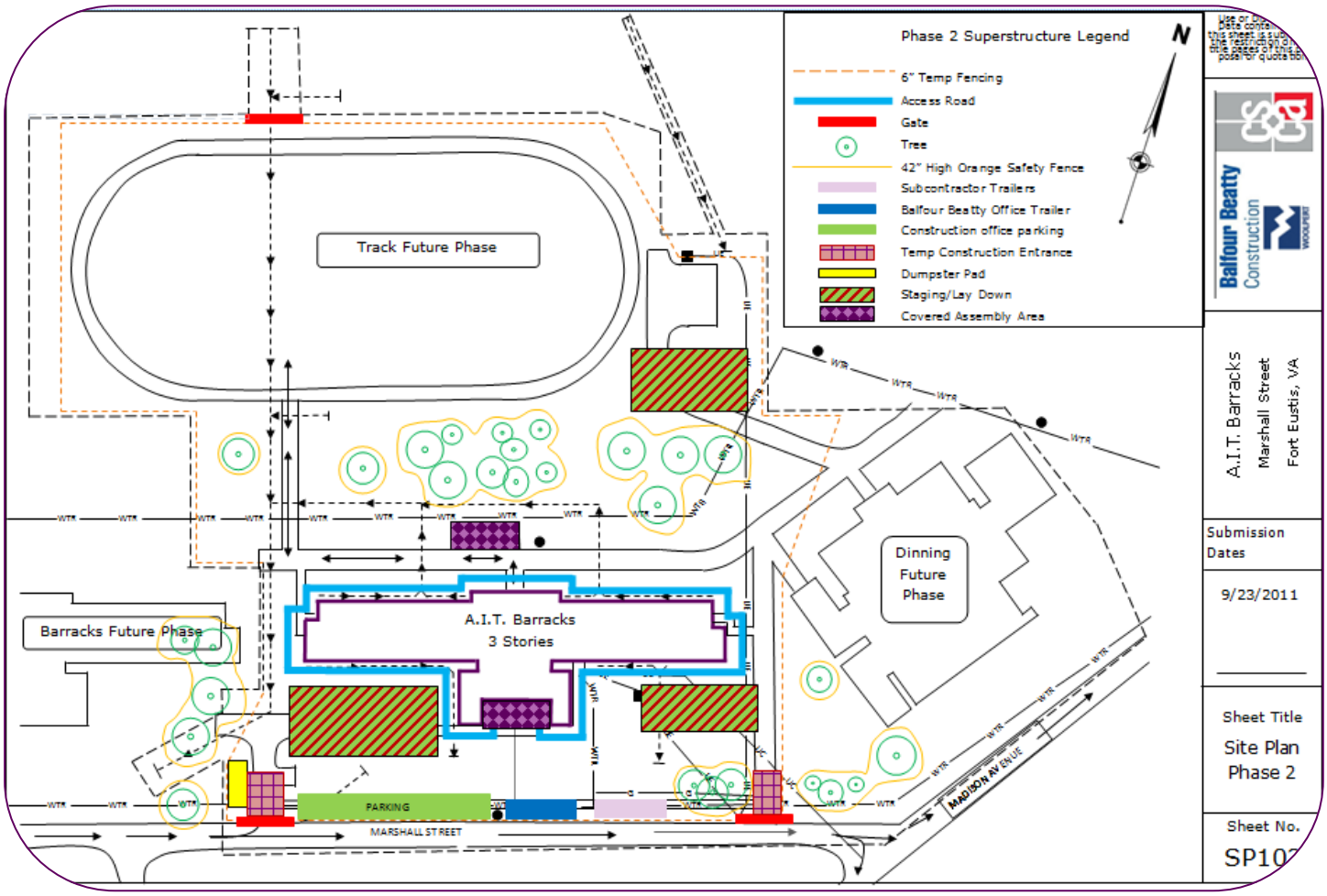


Fig 8. Phase 2 Superstructure

Phase 2 Superstructure site plan has the addition of site laydown areas and covered assembly areas. These areas were very well placed and accessible for all parties involved in construction. The crane was a small crane and is not shown on the site plan. This is because the crane moved when needed and was not in one given place. When critiquing the layout it is found to have spacious laydown areas and covered assembly areas benefiting the site in unforeseen conditions.

Site Layout Planning

See Appendix E For 11”x17” Phase 3 Finishes Site Plan

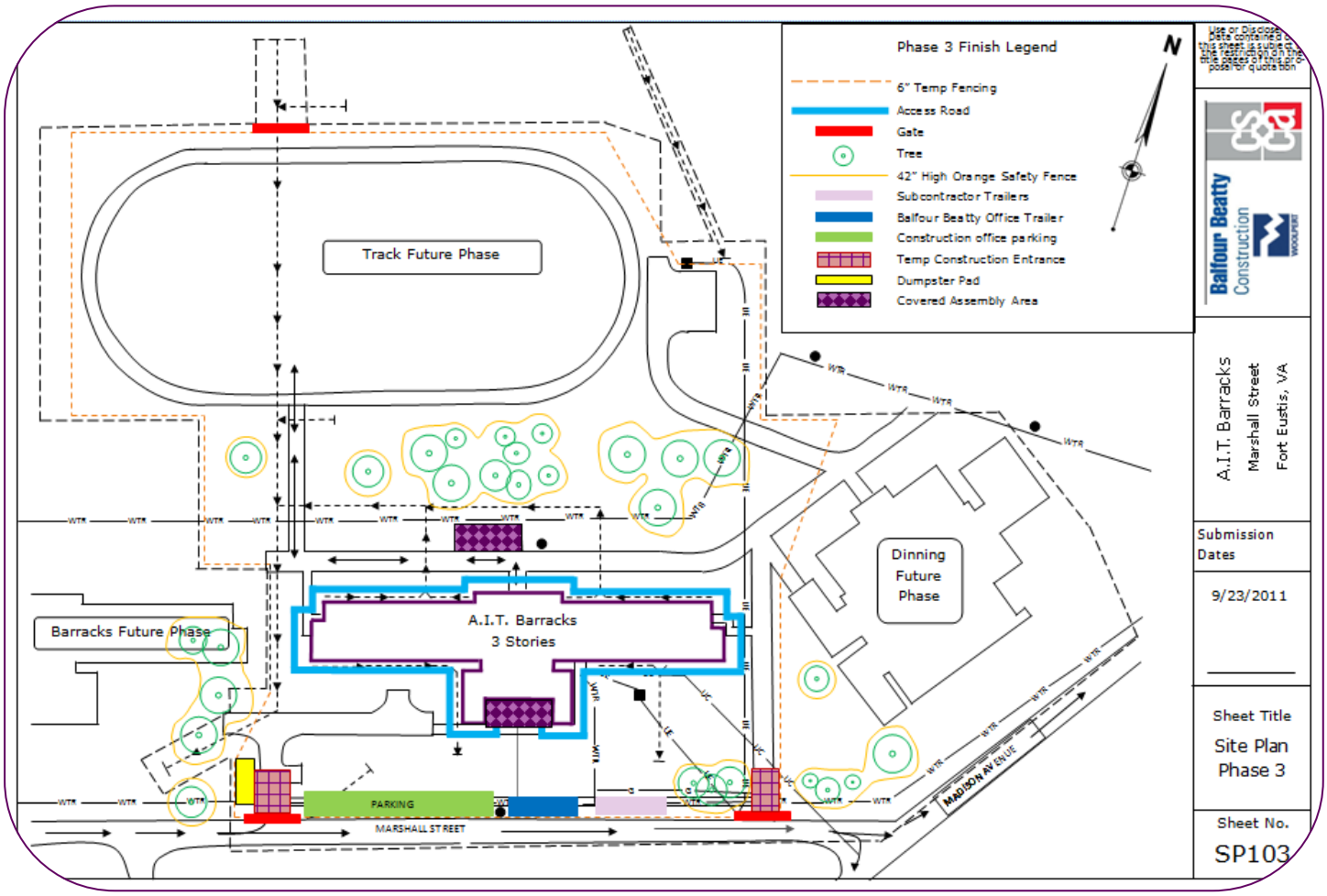


Fig 9. Phase 3 Finishes

Phase 3 Finishes has the deduction of the site laydown areas. These areas are not necessary for this phase. This phase requires the hydraulic lift scaffolding previously discussed, it will be located around the building one side at a time. When critiquing the layout it is found to have a excellent open plan so scaffolding can easily be set up and finishes entering the building have a direct path.

Local Conditions

The A.I.T. site is located at the northwest corner of the intersection between Marshall street and Madison Avenue at Fort Eustis, Virginia. After reviewing the Geologic Map of Virginia (Virginia Department of Mineral Resources, 1993), the project site is located in the Coastal Plan Physiographic Province of Virginia. The Coastal Plain is characterized by flat land to gently rolling hills and valleys. The Coastal Plain is a wedge of mostly marine sediments that gradually thickens to the east. The site is underlain by the Shirley Formation. Deposits may include light-to-dark-gray, bluish-gray, and brown sand, gravel, silt, clay, and peat. Figure 10 shows the existing site conditions before construction began.

Fig 10. Existing site condition

The Subsurface water depth at the end of the day in feet ranged from 18 to 8. This fluctuation of several feet could vary because of seasonal fluctuations in precipitation, evaporation, surface water runoff, local topography, and other factors.

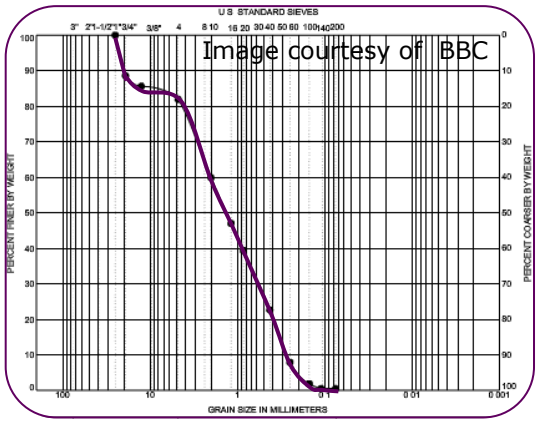


Fig 11. Sieve Analysis

Based on the Sieve analysis shown in figure 11 the soil content is as follows:

18.1% Gravel	81.5% Sand	0.5% Fines

The Soil description of this area is poorly graded sand with gravel fine to medium sand, fine to coarse gravel. It is recommended to stockpile topsoil for later use.

Local Conditions


Fig 12. Dewatering system

The dewatering system used on site was a trench system as seen in figure 12. The water was drained into strategically placed trenches that effectively eliminated water issues onsite.

After reviewing the Draper Aden Associates 2011 Virginia Tipping Fee and Recycling report it was found that the average tipping fee for 2011 Residential was $44.68/TON, and Commercial was $47.50/TON. Fort Eustis is located in the city of Newport News, It was found that in this locality recycled materials were collected in at private drop centers as well as private curbside. The top five materials recycled were newspaper, #1 plastics, #2 plastics, aluminum cans, and white goods respectfully. The bottom five materials recycled were #4 plastics, fluorescent bulbs, #7 plastics, #6 plastics, and textiles respectfully.

Parking availability for this site was not a problem, as parking was readily available.

Fort Eustis Army base is located in the city of Newport News which is in the Peninsula District. The Peninsula District is in the Tidewater Region of Virginia. The city of Newport News has many bylaws, a rule made by a company or society to control the actions of its members. No bylaws for the A.I.T. Barracks were found at this time.

The permitting office is located a the Department of Engineering on the 8th floor, City Hall 2400 Washington Ave Newport News, VA 23607. At the permit office many permits and applications can be obtained, permit fees that are applicable are stated. Permits that are relevant to the A.I.T. Barracks are building permits, electrical permits, mechanical permits, and others. The A.I.T. Barracks also has permit fees such as sewer tap fee, and building, electrical, mechanical, and plumbing permit fees.

Client Information

The owner of the project is the Army Corps of Engineers. There mission is to provide vital public engineering services in peace and war to strengthen out Nation's security, energize the economy, and reduce risks from disasters. The overall design approach for the building embodies the intent of the Department of the Army's Advanced Individual Training (A.I.T.) Barracks program, and its essential role to promote and maintain the well-being, morale and efficiency of the Army personnel by establishing a higher standard of living and quality of life. This building is being built because of the increased need of living facilities on the Army base.

The schedule of this building is very critical, the Army would like to occupy the building as soon as possible. Cost of the building is expected to stay under budget and maintain excellent quality. The Army Corps of Engineers have very high expectations when safety is discussed. Walk thoughts and safety checks are a daily occurrence at the Fort Eustis site. The barracks is a newly constructed building and will be entirely completed before occupants fill the building. There are 150 sleeping modules intended to house a total of 300 A.I.T. soldiers.

One sequencing concern that has arisen from this design build project is that the building was being constructed before the mechanical design was fully completed. It was found that more joists were needed to support the mechanical design. These joists were placed out of sequence.

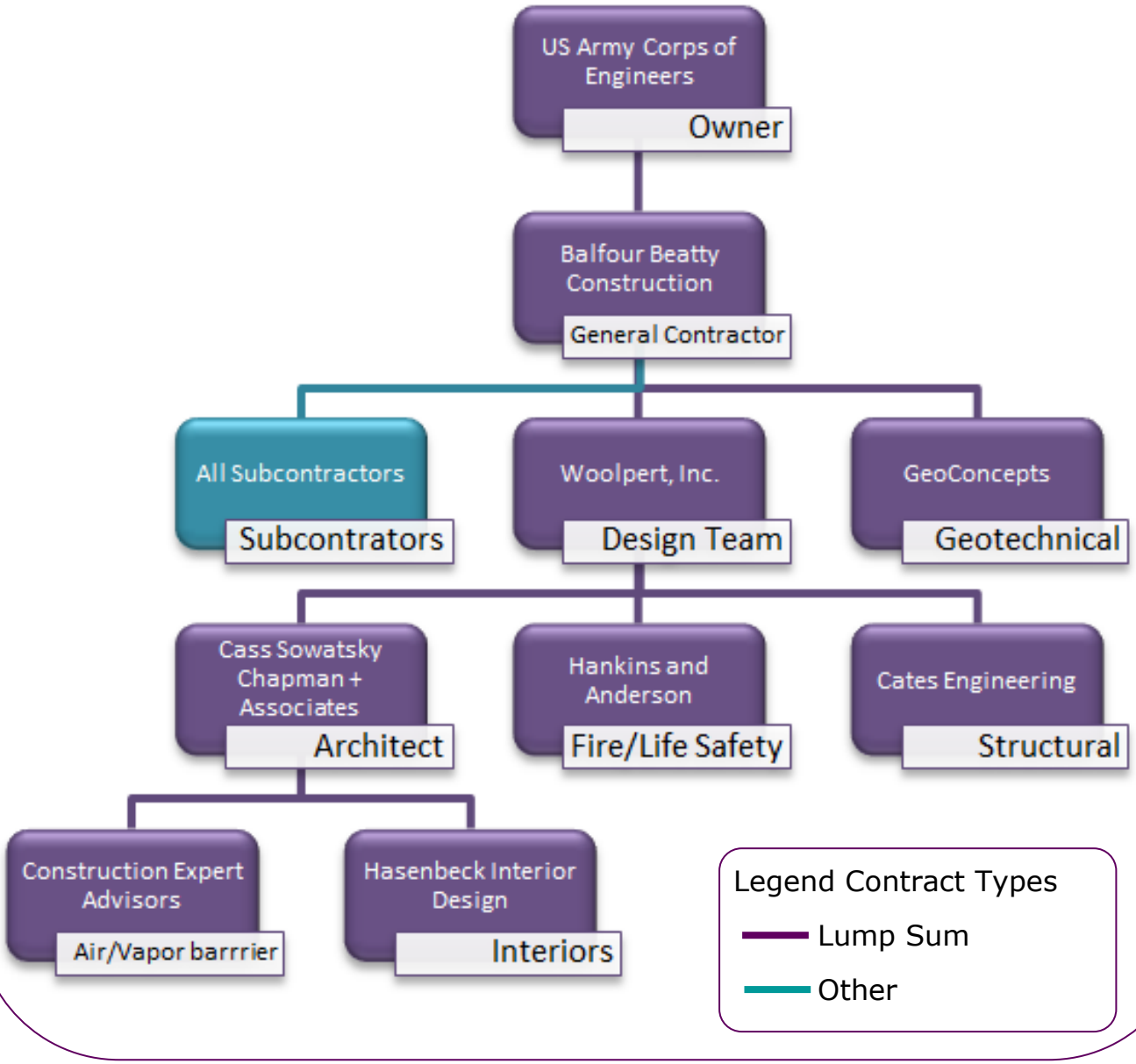
The keys to completing the project to owner's satisfaction is to complete the project on time. This project is expected to be completed on time so that the total of 300 A.I.T. soldiers can occupy the space. Completing the project on time means following the schedule and handling issues as they arise in a professional and timely manor. An on time completing is projected to be accomplished at this given time.

US Army Corps of Engineers
Headquarters

Image courtesy of U.S. Army Corps of Engineers

Project Delivery System

A.I.T. Barracks Organizational Chart



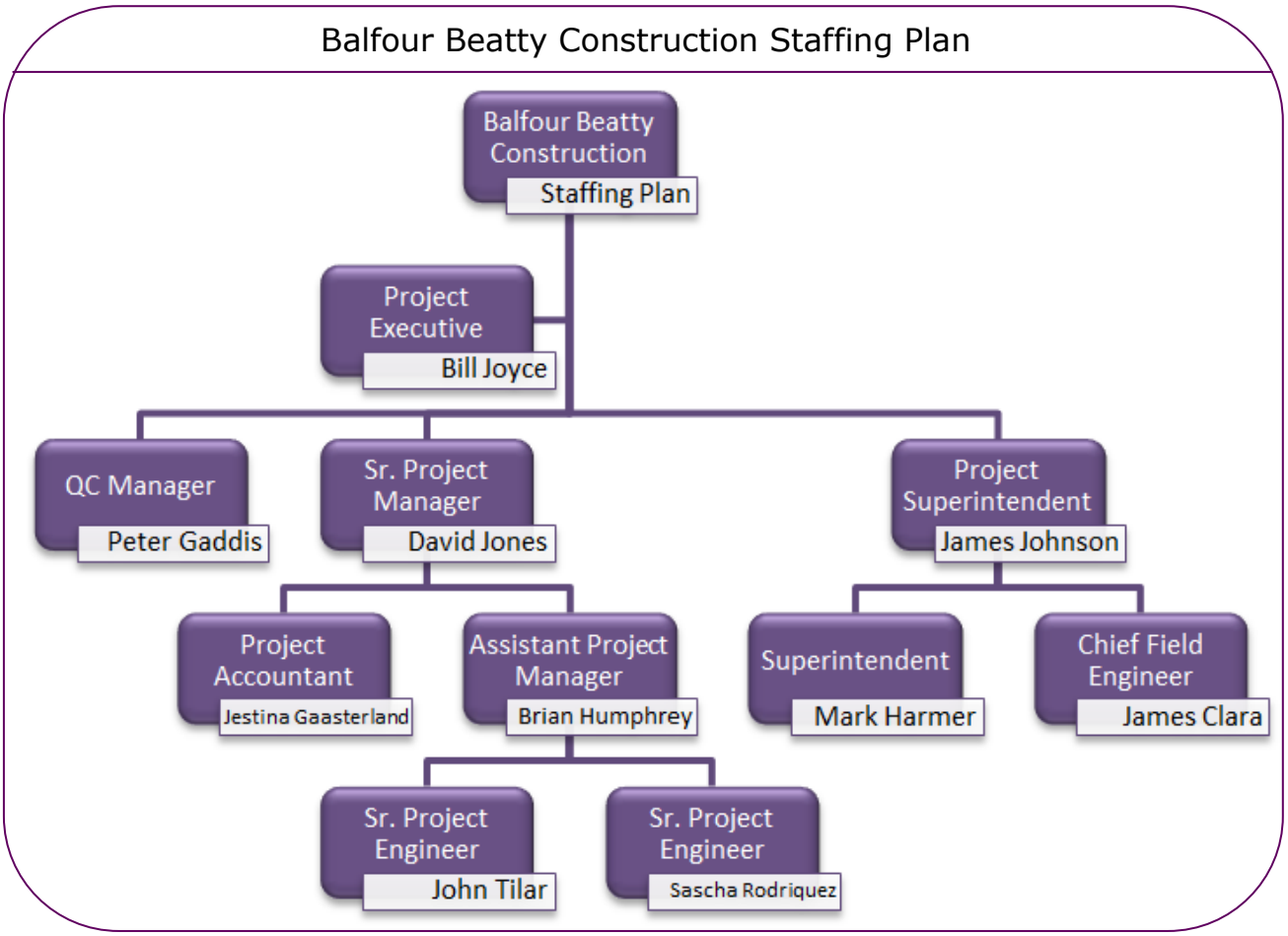
Project Delivery System

The Project is being delivered as a Design-Build Project. This project approach was chosen because of the need for the facility to be occupied as soon as possible.

The majority of contracts held between the contractors for the A.I.T. Barracks are Lump Sum contracts. The U.S Army Corps of Engineers has a Lump Sum contract directly with Balfour Beatty Construction. Balfour Beatty Construction was chosen as the General Contractor through a Multiple Award Task Order Contract (MATOC). Three General Contractors were able to bid the project because of the MATOC. Balfour Beatty Construction was awarded the contract because of their best value approach. As general contractor Balfour Beatty Construction manages all subcontractors and specialty contractors. An integrated project team is assembled at Balfour Beatty Construction for the selection of the design team. The design team selected was Woolpert; they are doing the mechanical, electrical, plumbing and civil all in house. Woolpert manages the other design partners i.e. the architect, fire and life safety, and structural, all parties have Lump Sum contracts with Woolpert. Balfour Beatty Construction is working directly with GeoConcepts under a Lump Sum contract to obtain the geotechnical information needed for site conditions.

Balfour Beatty Construction is working directly with all subcontractors needed for the project. The contracts that Balfour Beatty Construction has between the subcontractors varies depending on the type of work. If the subcontractor is only providing the material (no labor) a Purchase Order is issued. Any Purchase Order over $100,000 required a supply bond. If the subcontractor is supplying materials and labor multiple contracts can be issued depending on how much the contract is for. A Short Form Subcontract is a contract that is less that $100,000 and does not require a payment and performance bond. A contract over $100,000 is a Long Form Subcontract and requires a payment and performance bond. Non-permanent items on site such as temp fencing, trailers,... etc. requires a Abbreviated Subcontract. If a subcontractor only provides a service such as surveying, photography,...etc. a Professional Services Agreement is issued.

Staffing Plan



Balfour Beatty Construction staffing consists of many key players in completing the A.I.T. Barracks successfully. Each member of the hierarchy has a job, here are some examples of what each person is in charge of. Sr. Project Manager, David Jones, is in charge of the entire project. Assistant Project Manager, Brian Humphrey, is handling the earthwork/utilities, concrete, structure, drywall, windows, division 10 items, and the gun vault door. Sr. Project Engineer and Assistant QC (quality control) Manager, Sascha Rodriguez, is in charge of all MEP. Sr. Project Engineer, John Tilar, is handling finishes-tile, flooring, paint, doors, hardware, frames, coiling doors, blinds, operable partitions, window wash anchors, rood, and bird screens.

Appendix A
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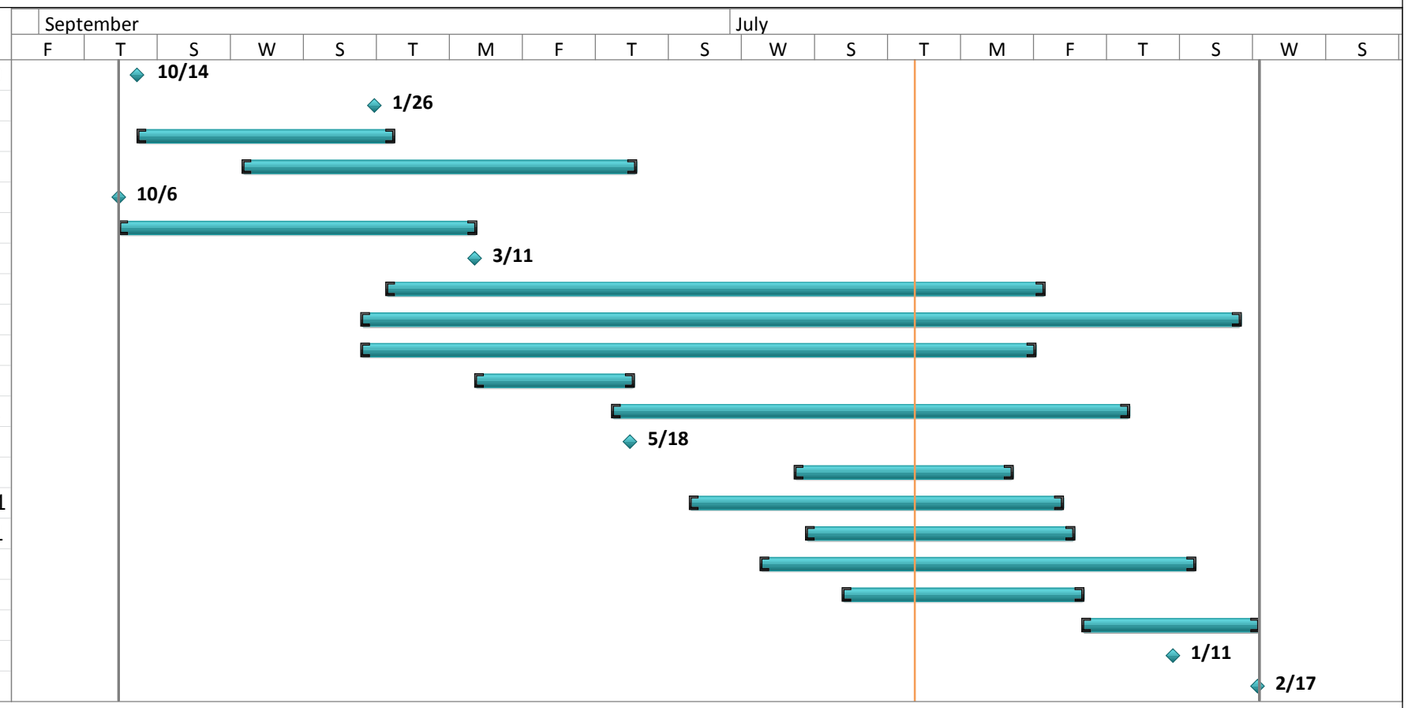
13		Final Design Documents Avaiable	0 days	Wed 5/18/11	Wed 5/18/11
14		Building Envelope	68 days	Fri 7/29/11	Tue 11/1/11
15		MEP Rough in (Inwall)	118 days	Mon 6/13/11	Wed 11/23/11
16		MEP Rough in (Overhead)	84 days	Wed 8/3/11	Mon 11/28/11
17		Interior Finishes	137 days	Thu 7/14/11	Fri 1/20/12
18		MEP Finishes	76 days	Fri 8/19/11	Fri 12/2/11
19		Punchlist	56 days	Fri 12/2/11	Fri 2/17/12
20		Quality Control Testing Complete	0 days	Wed 1/11/12	Wed 1/11/12
21		Project Substantial Completion	0 days	Fri 2/17/12	Fri 2/17/12



Project: A.I.T. Barracks
Name: Natalie Bockhorst

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

Appendix B
R.S. Means Data

CostWorks® RSMeans **Square Foot Cost Estimate Report**

Back Print Export

Estimate Name: **Untitled**	
Building Type:	**College, Dormitory, 2-3 Story with Decorative Concrete Block / Steel Frame**
Location:	**National Average**
Stories:	**3**
Story Height (L.F.):	**13**
Floor Area (S.F.):	**91800**
Labor Type:	**Union**
Basement Included:	**No**
Data Release:	**Year 2011**
Cost Per Square Foot:	**$131.92**
Building Cost:	**$12,110,500**

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 S.F.	Cost
A	**Substructure**	**3.0%**	**$4.01**	**$368,500**
A1010	**Standard Foundations**		**$1.67**	**$153,000**
	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**		**$1.66**	**$152,000**
	Slab on grade, 4" thick, non industrial, reinforced			
A2010	**Basement Excavation**		**$0.05**	**$5,000**
	Excavate and fill, 30,000 SF, 4' deep, sand, gravel, or common earth, on site storage			
A2020	**Basement Walls**		**$0.64**	**$58,500**
	Foundation wall, CIP, 4' wall height, direct chute, .148 CY/LF, 7.2 PLF, 12" thick			
B	**Shell**	**27.3%**	**$35.98**	**$3,303,000**
B1010	**Floor Construction**		**$21.01**	**$1,929,000**
	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 load, 130 PSF total			
B1020	**Roof Construction**		**$6.29**	**$577,000**
	Floor, composite slab on steel beam, 20'x25' bay, 4"slab, 20 " total depth40 PSF superimposed load, 94 PSF total load			
B2010	**Exterior Walls**		**$3.85**	**$353,000**
	Concrete block (CMU) wall, split rib, 8 ribs, hollow, regular weight, 8x8x16, reinforced, vertical #5@32", grouted			
B2020	**Exterior Windows**		**$2.03**	**$186,000**
	Windows, aluminum, awning, insulated glass, 4'-5" x 5'-3"			
B2030	**Exterior Doors**		**$1.36**	**$125,000**
	Door, aluminum & glass, without transom, full vision, double door, hardware, 6'-0" x 7'-0" opening			
B3010	**Roof Coverings**		**$1.45**	**$133,000**
	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"			
	Gravel stop, aluminum, extruded, 4", mill finish, .050" thick			

C Interiors	23.5%	$31.05	$2,850,500
C1010 Partitions		**$6.61**	**$607,000**
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 rated opposite face, 3.5"fiberglas insulation			
C1020 Interior Doors		**$6.58**	**$604,000**
Door, single leaf, wood frame, 3'-0" x 7'-0" x 1-3/8", birch, solid core			
C1030 Fittings		**$1.74**	**$160,000**
Bathroom accessories, stainless steel, mirror, framed, with shelf, 72" x 24"			
C2010 Stair Construction		**$2.49**	**$229,000**
Stairs, CIP concrete, w/landing, 12 risers, with nosing			
C3010 Wall Finishes		**$3.24**	**$297,000**
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		**$9.43**	**$866,000**
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		**$0.95**	**$87,500**
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**	**43.2%**	**$56.96**	**$5,228,500**
D1010	**Elevators and Lifts**		**$4.35**	**$399,000**
	Hydraulic passenger elevator, 4000 lb., 3 floor, 12' story height, 125 FPM			
D2010	**Plumbing Fixtures**		**$19.71**	**$1,809,000**
	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**		**$0.92**	**$84,500**
	Electric water heater, commercial, 100< F rise, 500 gal, 240 KW 984 GPH			
D2040	**Rain Water Drainage**		**$0.11**	**$10,500**
	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**		**$11.90**	**$1,092,500**
	Rooftop, multizone, air conditioner, medical centers, 25,000 SF, 58.33 ton			
D4010	**Sprinklers**		**$2.85**	**$261,500**
	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**		**$0.73**	**$67,000**
	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			
D5010	**Electrical Service/Distribution**		**$0.70**	**$64,000**
	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**		**$9.16**	**$840,500**
	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			

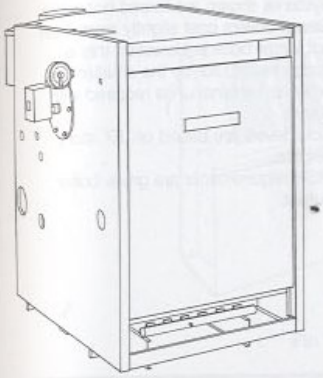
D5030	**Communications and Security**		**$6.45**	**$592,500**
	Telephone wiring for offices & laboratories, 8 jacks/MSF			
	Communication and alarm systems, fire detection, addressable, 25 detectors, includes outlets, boxes, conduit and wire			
	Fire alarm command center, addressable with voice, excl. 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 outlets			
	Internet wiring, 8 data/voice outlets per 1000 S.F.			
D5090	**Other Electrical Systems**		**$0.08**	**$7,500**
	Generator sets, w/battery, charger, muffler and transfer switch, gas/gasoline operated, 3 phase, 4 wire, 277/480 V, 7.5 kW			
E	**Equipment & Furnishings**	**3.0%**	**$3.92**	**$360,000**
E1090	**Other Equipment**		**$0.00**	**$0**
E2020	**Moveable Furnishings**		**$3.92**	**$360,000**
	Furnishings, dormitory furniture, dressing unit, built-in, deluxe			
F	**Special Construction**	**0.0%**	**$0.00**	**$0**
G	**Building Sitework**	**0.0%**	**$0.00**	**$0**

SubTotal	**100%**	**$131.92**	**$12,110,500**
Contractor Fees (GC,Overhead,Profit)	**0.0%**	**$0.00**	**$0**
Architectural Fees	**0.0%**	**$0.00**	**$0**
User Fees	**0.0%**	**$0.00**	**$0**
Total Building Cost		**$131.92**	**$12,110,500**

Appendix C
R.S. Means Assemblies Data

D30 HVAC

D3020 Heat Generating Systems



Boiler Selection: The maximum allowable working pressures are limited by ASME "Code for Heating Boilers" to 15 PSI for steam and 160 PSI for hot water heating boilers, with a maximum temperature limitation of 250°F. Hot water boilers are generally rated for a working pressure of 30 PSI. High pressure boilers are governed by the ASME "Code for Power Boilers" which is used almost universally for boilers operating over 15 PSIG. High pressure boilers used for a combination of heating/process loads are usually designed for 150 PSIG.

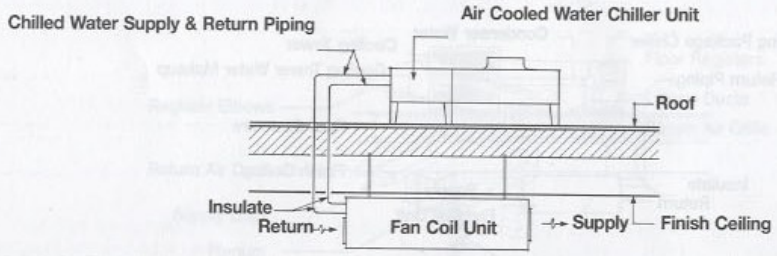
Boiler ratings are usually indicated as either Gross or Net Output. The Gross Load is equal to the Net Load plus a piping and pickup allowance. When this allowance cannot be determined, divide the gross output rating by 1.25 for a value equal to or greater than the next heat loss requirement of the building.

Table below lists installed cost per boiler and includes insulating jacket, standard controls, burner and safety controls. Costs do not include piping or boiler base pad. Outputs are Gross.

D3020 106	Boilers, Hot Water & Steam		COST EACH		
			MAT.	INST.	TOTAL
0600	Boiler, electric, steel, hot water, 12 K.W., 41 M.B.H.		4,200	1,350	5,550
0620	30 K.W., 103 M.B.H.		5,000	1,475	6,475
0640	60 K.W., 205 M.B.H.	RD3020 -010	6,125	1,600	7,725
0660	120 K.W., 410 M.B.H.		6,875	1,950	8,825
0680	210 K.W., 716 M.B.H.	RD3020 -020	8,050	2,925	10,975
0700	510 K.W., 1,739 M.B.H.		19,500	5,475	24,975
0720	720 K.W., 2,452 M.B.H.		23,600	6,175	29,775
0740	1,200 K.W., 4,095 M.B.H.		30,500	7,075	37,575
0760	2,100 K.W., 7,167 M.B.H.		58,500	8,900	67,400
0780	3,600 K.W., 12,283 M.B.H.		89,500	15,000	104,500
0820	Steam, 6 K.W., 20.5 M.B.H.		4,000	1,475	5,475
0840	24 K.W., 81.8 M.B.H.		4,975	1,600	6,575
0860	60 K.W., 205 M.B.H.		6,875	1,750	8,625
0880	150 K.W., 512 M.B.H.		9,900	2,700	12,600
0900	510 K.W., 1,740 M.B.H.		25,100	6,675	31,775
0920	1,080 K.W., 3,685 M.B.H.		35,100	9,625	44,725
0940	2,340 K.W., 7,984 M.B.H.		72,000	15,000	87,000
0980	Gas, cast iron, hot water, 80 M.B.H.		2,050	1,675	3,725
1000	100 M.B.H.		2,625	1,825	4,450
1020	163 M.B.H.		3,200	2,450	5,650
1040	280 M.B.H.		4,725	2,725	7,450
1060	544 M.B.H.		9,400	4,850	14,250
1080	1,088 M.B.H.		14,200	6,150	20,350
1100	2,000 M.B.H.		20,500	9,625	30,125
1120	2,856 M.B.H.		24,600	12,300	36,900
1140	4,720 M.B.H.		77,000	17,000	94,000
1160	6,970 M.B.H.		93,000	27,700	120,700
1180	For steam systems under 2,856 M.B.H., add 8%				
1520	Oil, cast iron, hot water, 109 M.B.H.		2,250	2,050	4,300
1540	173 M.B.H.		2,850	2,450	5,300
1560	236 M.B.H.		3,675	2,900	6,575
1580	1,084 M.B.H.		10,300	6,550	16,850
1600	1,600 M.B.H.		13,300	9,400	22,700
1620	2,480 M.B.H.		20,400	12,000	32,400
1640	3,550 M.B.H.		26,300	14,400	40,700
1660	Steam systems same price as hot water				

D30 HVAC

D3030 Cooling Generating Systems



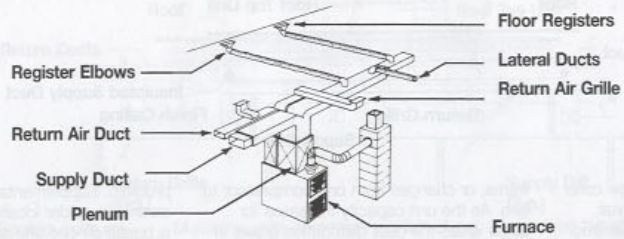
Design Assumptions: The chilled water, air cooled systems priced, utilize reciprocating hermetic compressors and propeller-type condenser fans. Piping with pumps and expansion tanks is included based on a two pipe system. No ducting is included and the fan-coil units are cooling only. Water treatment and balancing are not included. Chilled water piping is insulated. Area distribution is through the use of multiple fan coil units. Fewer but larger fan coil units with duct distribution would be approximately the same S.F. cost.

System Components	QUANTITY	UNIT	COST EACH MAT.	COST EACH INST.	COST EACH TOTAL
SYSTEM D3030 110 1200					
PACKAGED CHILLER, AIR COOLED, WITH FAN COIL UNIT					
APARTMENT CORRIDORS, 3,000 S.F., 5.50 TON					
Fan coil air conditioning unit, cabinet mounted & filters chilled water	1.000	Ea.	3,482.70	533.40	4,016.10
Water chiller, air conditioning unit, air cooled	1.000	Ea.	7,975	1,993.75	9,968.75
Chilled water unit coil connections	1.000	Ea.	1,275	1,450	2,725
Chilled water distribution piping	440.000	L.F.	7,832	19,580	27,412
TOTAL			20,564.70	23,557.15	44,121.85
COST PER S.F.			6.85	7.85	14.70

D3030 110	Chilled Water, Air Cooled Condenser Systems		COST PER S.F. MAT.	COST PER S.F. INST.	COST PER S.F. TOTAL
1180	Packaged chiller, air cooled, with fan coil unit				
1200	Apartment corridors, 3,000 S.F., 5.50 ton		6.87	7.87	14.74
1360	40,000 S.F., 73.33 ton	RID3030 -010	4.17	3.51	7.68
1440	Banks and libraries, 3,000 S.F., 12.50 ton		11.05	9.25	20.30
1560	20,000 S.F., 83.33 ton		7.55	4.75	12.30
1680	Bars and taverns, 3,000 S.F., 33.25 ton		18.30	11	29.30
1760	10,000 S.F., 110.83 ton		13.40	2.74	16.14
1920	Bowling alleys, 3,000 S.F., 17.00 ton		14.15	10.40	24.55
2040	20,000 S.F., 113.33 ton		8.50	4.83	13.33
2160	Department stores, 3,000 S.F., 8.75 ton		9.75	8.75	18.50
2320	40,000 S.F., 116.66 ton		5.45	3.63	9.08
2400	Drug stores, 3,000 S.F., 20.00 ton		16.15	10.75	26.90
2520	20,000 S.F., 133.33 ton		10.55	5.10	15.65
2640	Factories, 2,000 S.F., 10.00 ton		9.60	8.90	18.50
2800	40,000 S.F., 133.33 ton		5.95	3.74	9.69
2880	Food supermarkets, 3,000 S.F., 8.50 ton		9.60	8.70	18.30
3040	40,000 S.F., 113.33 ton		5.15	3.64	8.79
3120	Medical centers, 3,000 S.F., 7.00 ton		8.55	8.50	17.05
3280	40,000 S.F., 93.33 ton		4.64	3.57	8.21
3360	Offices, 3,000 S.F., 9.50 ton		8.85	8.65	17.50
3520	40,000 S.F., 126.66 ton		5.85	3.75	9.60
3600	Restaurants, 3,000 S.F., 15.00 ton		12.55	9.60	22.15
3720	20,000 S.F., 100.00 ton		8.65	5.05	13.70
3840	Schools and colleges, 3,000 S.F., 11.50 ton		10.50	9.10	19.60
3960	20,000 S.F., 76.66 ton		7.35	4.81	12.16

D30 HVAC

D3030 Cooling Generating Systems

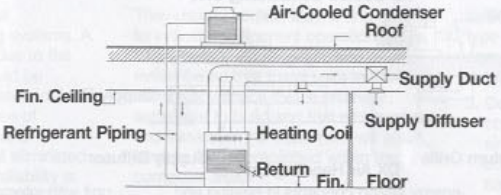


System Components	QUANTITY	UNIT	COST EACH MAT.	COST EACH INST.	COST EACH TOTAL
SYSTEM D3030 214 1200 HEATING/COOLING, GAS FIRED FORCED AIR, ONE ZONE, 1200 SF BLDG, SEER 14					
Thermostat manual	1.000	Ea.	49	81	130
Intermittent pilot	1.000	Ea.	165		165
Furnace, 3 Ton cooling, 115 MBH	1.000	Ea.	2,125	375	2,500
Cooling tubing 25 feet	1.000	Ea.	267		267
Ductwork	158.000	Lb.	115.34	1,177.10	1,292.44
Ductwork connection	12.000	Ea.	360	225	585
Supply ductwork	176.000	SF Surf	149.60	880	1,029.60
Supply grill	2.000	Ea.	52	57	109
Duct insulation	1.000	L.F.	377.28	623.52	1,000.80
Return register	1.000	Ea.	354	234.60	588.60
TOTAL			4,014.22	3,653.22	7,667.44

D3030 214	Heating/Cooling System	COST EACH MAT.	COST EACH INST.	COST EACH TOTAL
1200	Heating/Cooling system, gas fired, SEER 14, 1200 SF Bldg	4,025	3,650	7,675
1300	2000 SF Bldg	5,200	5,775	10,975
1400	Heating/Cooling system, heat pump 3 ton, SEER 14, 1200 SF Bldg	6,650	4,725	11,375
1500	5 ton, SEER 14, 2000 SF Bldg	8,950	5,400	14,350

D30 HVAC

D3050 Terminal & Package Units



System Description: Self-contained air cooled units with remote air cooled condenser and interconnecting tubing. Systems for 1000 S.F. and up include duct and diffusers. Smaller units distribute air directly.

Returns are not ducted and supplies are not insulated.

Potential savings may be realized by using a single zone rooftop system or through-the-wall unit, especially in the smaller capacities, if the application permits.

Hot water or steam heating coils are included but piping to boiler and the boiler itself is not included.

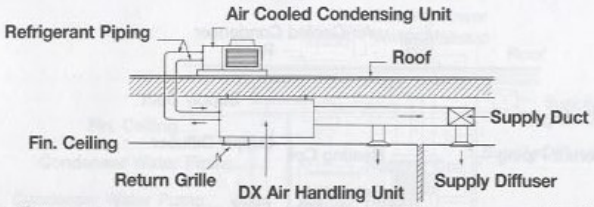
Condenserless models are available for 15% less where remote refrigerant source is available.

System Components	QUANTITY	UNIT	COST EACH MAT.	COST EACH INST.	COST EACH TOTAL
SYSTEM D3050 165 1320					
SELF-CONTAINED, AIR COOLED UNIT					
APARTMENT CORRIDORS, 500 S.F., .92 TON					
Air cooled, package unit	1.000	Ea.	1,300.50	399.50	1,700
Ductwork package for water or air cooled packaged units	1.000	System	70.84	818.80	889.64
Refrigerant piping	1.000	System	487.60	533.60	1,021.20
Air cooled condenser, direct drive, propeller fan	1.000	Ea.	341	150.35	491.35
TOTAL			2,199.94	1,902.25	4,102.19
COST PER S.F.			4.40	3.80	8.20

D3050 165	Self-contained, Air Cooled Unit Systems		COST PER S.F. MAT.	COST PER S.F. INST.	COST PER S.F. TOTAL
1300	Self-contained, air cooled unit				
1320	Apartment corridors, 500 S.F., .92 ton		4.40	3.80	8.20
1480	10,000 S.F., 18.33 ton	RD3030 -010	3.31	3.07	6.38
1560	Banks or libraries, 500 S.F., 2.08 ton		9.50	4.86	14.36
1720	10,000 S.F., 41.66 ton		7.95	6.85	14.80
1800	Bars and taverns, 500 S.F., 5.54 ton		19.70	10.60	30.30
1960	10,000 S.F., 110.00 ton		21.50	13.10	34.60
2040	Bowling alleys, 500 S.F., 2.83 ton		13	6.65	19.65
2200	10,000 S.F., 56.66 ton		11.10	9.25	20.35
2240	Department stores, 500 S.F., 1.46 ton		6.70	3.41	10.11
2400	10,000 S.F., 29.17 ton		5.50	4.78	10.28
2480	Drug stores, 500 S.F., 3.33 ton		15.30	7.80	23.10
2640	10,000 S.F., 66.66 ton		13.10	10.90	24
2720	Factories, 500 S.F., 1.66 ton		7.75	3.94	11.69
2880	10,000 S.F., 33.33 ton		6.30	5.45	11.75
3200	Medical centers, 500 S.F., 1.17 ton		5.40	2.74	8.14
3360	10,000 S.F., 23.33 ton		4.23	3.91	8.14
3440	Offices, 500 S.F., 1.58 ton		7.30	3.71	11.01
3600	10,000 S.F., 31.66 ton		5.95	5.20	11.15
3680	Restaurants, 500 S.F., 2.50 ton		11.45	5.85	17.30
3840	10,000 S.F., 50.00 ton		9.90	8.15	18.05
3920	Schools and colleges, 500 S.F., 1.92 ton		8.80	4.49	13.29
4080	10,000 S.F., 38.33 ton		7.30	6.30	13.60

D30 HVAC

D3050 Terminal & Package Units



General: Split systems offer several important advantages which should be evaluated when a selection is to be made. They provide a greater degree of flexibility in component selection which permits an accurate match-up of the proper equipment size and type with the particular needs of the building. This allows for maximum use of modern energy saving concepts in heating and cooling. Outdoor installation of the air cooled condensing unit allows space savings in the building and also isolates the equipment operating sounds from building occupants.

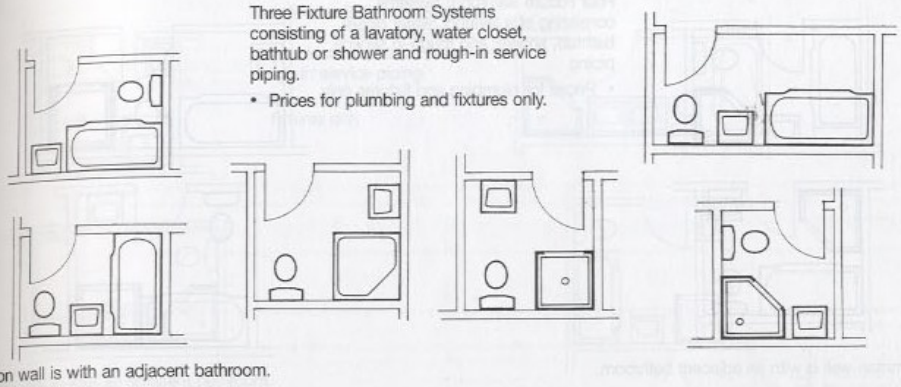
Design Assumptions: The systems below are comprised of a direct expansion air handling unit and air cooled condensing unit with interconnecting copper tubing. Ducts and diffusers are also included for distribution of air. Systems are priced for cooling only. Heat can be added as desired either by putting hot water/steam coils into the air unit or into the duct supplying the particular area of need. Gas fired duct furnaces are also available. Refrigerant liquid line is insulated.

System Components	QUANTITY	UNIT	COST EACH MAT.	COST EACH INST.	COST EACH TOTAL
SYSTEM D3050 170 1280					
SPLIT SYSTEM, AIR COOLED CONDENSING UNIT					
APARTMENT CORRIDORS, 1,000 S.F., 1.80 TON					
Fan coil AC unit, cabinet mntd & filters direct expansion air cool	1.000	Ea.	530.70	142.74	673.44
Ductwork package, for split system, remote condensing unit	1.000	System	66.34	777.75	844.09
Refrigeration piping	1.000	System	409.92	887.55	1,297.47
Condensing unit, air cooled, incls compressor & standard controls	1.000	Ea.	1,494.50	567.30	2,061.80
TOTAL			2,501.46	2,375.34	4,876.80
COST PER S.F.			2.50	2.38	4.88

D3050 170	Split Systems With Air Cooled Condensing Units		COST PER S.F. MAT.	COST PER S.F. INST.	COST PER S.F. TOTAL
1260	Split system, air cooled condensing unit				
1280	Apartment corridors, 1,000 S.F., 1.83 ton		2.50	2.38	4.88
1440	20,000 S.F., 36.66 ton	RD3030 -010	2.65	3.33	5.98
1520	Banks and libraries, 1,000 S.F., 4.17 ton		4.40	5.45	9.85
1680	20,000 S.F., 83.32 ton		7.15	7.90	15.05
1760	Bars and taverns, 1,000 S.F., 11.08 ton		11.30	10.75	22.05
1880	10,000 S.F., 110.84 ton		15.70	12.55	28.25
2000	Bowling alleys, 1,000 S.F., 5.66 ton		6.10	10.20	16.30
2160	20,000 S.F., 113.32 ton		10.70	11.15	21.85
2320	Department stores, 1,000 S.F., 2.92 ton		3.12	3.75	6.87
2480	20,000 S.F., 58.33 ton		4.22	5.30	9.52
2560	Drug stores, 1,000 S.F., 6.66 ton		7.15	12	19.15
2720	20,000 S.F., 133.32 ton*				
2800	Factories, 1,000 S.F., 3.33 ton		3.56	4.28	7.84
2960	20,000 S.F., 66.66 ton		5.20	6.35	11.55
3040	Food supermarkets, 1,000 S.F., 2.83 ton		3.01	3.63	6.64
3200	20,000 S.F., 56.66 ton		4.10	5.15	9.25
3280	Medical centers, 1,000 S.F., 2.33 ton		2.68	2.94	5.62
3440	20,000 S.F., 46.66 ton		3.38	4.23	7.61
3520	Offices, 1,000 S.F., 3.17 ton		3.38	4.08	7.46
3680	20,000 S.F., 63.32 ton		4.95	6	10.95
3760	Restaurants, 1,000 S.F., 5.00 ton		5.40	9	14.40
3920	20,000 S.F., 100.00 ton		9.45	9.85	19.30
4000	Schools and colleges, 1,000 S.F., 3.83 ton		4.05	5.05	9.10
4160	20,000 S.F., 76.66 ton		6	7.25	13.25

D20 Plumbing

D2010 Plumbing Fixtures



Three Fixture Bathroom Systems consisting of a lavatory, water closet, bathtub or shower and rough-in service piping.

- Prices for plumbing and fixtures only.

*Common wall is with an adjacent bathroom.

System Components	QUANTITY	UNIT	COST EACH MAT.	COST EACH INST.	COST EACH TOTAL
SYSTEM D2010 924 1170					
BATHROOM, LAVATORY, WATER CLOSET & BATHTUB					
ONE WALL PLUMBING, STAND ALONE					
Wtr closet, 2 pc close cpld vit china flr mntd w/seat supply & stop	1.000	Ea.	265	217	482
Water closet, rough-in waste & vent	1.000	Set	335	380	715
Lavatory w/ftngs, wall hung, white, PE on CI, 20" x 18"	1.000	Ea.	380	144	524
Lavatory, rough-in waste & vent	1.000	Set	460	695	1,155
Bathtub, white PE on CI, w/ftgs, mat bottom, recessed, 5' long	1.000	Ea.	1,100	262	1,362
Baths, rough-in waste and vent	1.000	Set	387	499.50	886.50
TOTAL			2,927	2,197.50	5,124.50

D2010 924	Three Fixture Bathroom, One Wall Plumbing	COST EACH MAT.	COST EACH INST.	COST EACH TOTAL
1150	Bathroom, three fixture, one wall plumbing			
1160	Lavatory, water closet & bathtub			
1170	Stand alone	2,925	2,200	5,125
1180	Share common plumbing wall *	2,525	1,575	4,100

D2010 926	Three Fixture Bathroom, Two Wall Plumbing	COST EACH MAT.	COST EACH INST.	COST EACH TOTAL
2130	Bathroom, three fixture, two wall plumbing			
2140	Lavatory, water closet & bathtub			
2160	Stand alone	2,950	2,225	5,175
2180	Long plumbing wall common *	2,650	1,775	4,425
3610	Lavatory, bathtub & water closet			
3620	Stand alone	3,250	2,525	5,775
3640	Long plumbing wall common *	3,000	2,300	5,300
4660	Water closet, corner bathtub & lavatory			
4680	Stand alone	4,300	2,250	6,550
4700	Long plumbing wall common *	3,875	1,700	5,575
6100	Water closet, stall shower & lavatory			
6120	Stand alone	3,075	2,525	5,600
6140	Long plumbing wall common *	2,875	2,325	5,200
7060	Lavatory, corner stall shower & water closet			
7080	Stand alone	3,375	2,225	5,600
7100	Short plumbing wall common *	2,725	1,500	4,225

D20 Plumbing

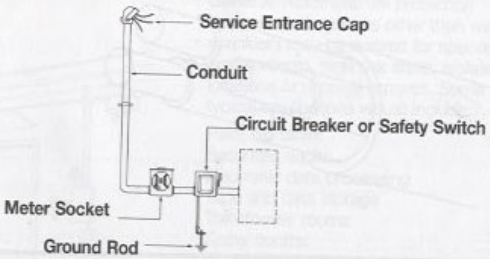
D2020 Domestic Water Distribution

System Components		QUANTITY	UNIT	COST EACH MAT.	COST EACH INST.	COST EACH TOTAL
SYSTEM D2020 295 2760						
SOLAR, CLOSED LOOP, HOT WATER SYSTEM, IMMERSED HEAT EXCHANGER						
3/4" TUBING, THREE 3' X 7' BLACK CHROME COLLECTORS						
A, B	Differential controller, 2 sensors, thermostat, solar energy system	1.000	Ea.	575	53.50	628.50
C	Thermometer 2" dial	3.000	Ea.	66	120	186
D, T	Fill & drain valves, brass, 3/4" connection	3.000	Ea.	34.95	79.50	114.45
E	Air vent, manual, 1/8" fitting	1.000	Ea.	3.06	20	23.06
F	Air purger	1.000	Ea.	47.50	53.50	101
G	Expansion tank	1.000	Ea.	67.50	20	87.50
I	Valve, gate, bronze, NRS, soldered 3/4" diam	3.000	Ea.	133.50	96	229.50
J	Neoprene vent flashing	2.000	Ea.	27.40	64	91.40
K	Circulator, solar heated liquid, 1/25 HP	1.000	Ea.	295	82.50	377.50
N-1, N	Relief valve, temp & press 150 psi 210°F self-closing 3/4" IPS	2.000	Ea.	34.30	43	77.30
O	Pipe covering, urethane ultraviolet cover, 1" wall, 3/4" diam	20.000	L.F.	48	114	162
P	Pipe covering, fiberglass, all service jacket, 1" wall, 3/4" diam	50.000	L.F.	57	227	284
	Roof clamps for solar energy collector panel	3.000	Set	7.77	49.35	57.12
Q	Collector panel solar blk chrome on copper, 1/8" temp glass, 3'x7'	3.000	Ea.	3,150	363	3,513
R-1	Valve, swing check, bronze, regrinding disc, 3/4" diam, soldered	1.000	Ea.	79	32	111
S	Pressure gauge, 60 psi, 2-1/2" dial	1.000	Ea.	24.50	20	44.50
U	Valve, water tempering, bronze, sweat connections, 3/4" diam	1.000	Ea.	125	32	157
W-2, W	Tank, water storage immersed heat exchr elec elem 2"x2# insul 120 Gal	1.000	Ea.	1,350	455	1,805
X	Valve, globe, bronze, rising stem, 3/4" diam, soldered	1.000	Ea.	112	32	144
	Copper tubing type L, solder joint, hanger 10' OC 3/4" diam	20.000	L.F.	131	168	299
	Copper tubing, type M, solder joint, hanger 10' OC 3/4" diam	70.000	L.F.	350	574	924
	Sensor wire, #22-2 conductor multistranded	.500	C.L.F.	8.25	29.75	38
	Solar energy heat transfer fluid, propylene glycol, anti-freeze	6.000	Gal.	79.50	138	217.50
	Wrought copper fittings & solder, 3/4" diam	76.000	Ea.	350.36	2,546	2,896.36
	TOTAL			7,156.59	5,412.10	12,568.69

D2020 295	Solar, Closed Loop, Hot Water Systems		COST EACH MAT.	COST EACH INST.	COST EACH TOTAL
2550	Solar, closed loop, hot water system, immersed heat exchanger				
2560	3/8" tubing, 3 ea. 4' x 4'-4" vacuum tube collectors, 80 gal. tank		6,575	4,925	11,500
2580	1/2" tubing, 4 ea. 4' x 4'-4" vacuum tube collectors, 80 gal. tank	RD3010 -600	7,175	5,300	12,475
2600	120 gal. tank		7,325	5,375	12,700
2640	2 ea. 3'x7' black chrome collectors, 80 gal. tank		5,575	5,075	10,650
2660	120 gal. tank		5,675	5,075	10,750
2760	3/4" tubing, 3 ea. 3'x7' black chrome collectors, 120 gal. tank		7,150	5,400	12,550
2780	3 ea. 3'x7' flat black collectors, 120 gal. tank		6,275	5,425	11,700
2840	1" tubing, 4 ea. 2'x9' plastic absorber & glazing collectors 120 gal. tank		7,150	6,100	13,250
2860	4 ea. 3'x7' black chrome collectors, 120 gal. tank		9,175	6,125	15,300

D50 Electrical

D5010 Electrical Service/Distribution

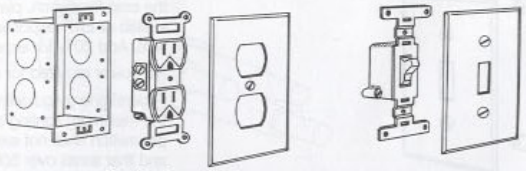


System Components	QUANTITY	UNIT	COST EACH MAT.	COST EACH INST.	COST EACH TOTAL
SYSTEM D5010 120 0220					
SERVICE INSTALLATION, INCLUDES BREAKERS, METERING, 20' CONDUIT & WIRE					
3 PHASE, 4 WIRE, 60 A					
Circuit breaker, enclosed (NEMA 1), 600 volt, 3 pole, 60 A	1.000	Ea.	655	213	868
Meter socket, single position, 4 terminal, 100 A	1.000	Ea.	48.50	186	234.50
Rigid galvanized steel conduit, 3/4", including fittings	20.000	L.F.	59.40	149	208.40
Wire, 600V type XHHW, copper stranded #6	.900	C.L.F.	91.80	82.35	174.15
Service entrance cap 3/4" diameter	1.000	Ea.	12.25	46	58.25
Conduit LB fitting with cover, 3/4" diameter	1.000	Ea.	15.75	46	61.75
Ground rod, copper clad, 8' long, 3/4" diameter	1.000	Ea.	35.50	112	147.50
Ground rod clamp, bronze, 3/4" diameter	1.000	Ea.	8.35	18.65	27
Ground wire, bare armored, #6-1 conductor	.200	C.L.F.	31.60	66	97.60
TOTAL			958.15	919	1,877.15

D5010 120	Electric Service, 3 Phase - 4 Wire	COST EACH MAT.	COST EACH INST.	COST EACH TOTAL
0200	Service installation, includes breakers, metering, 20' conduit & wire			
0220	3 phase, 4 wire, 120/208 volts, 60 A	960	920	1,880
0240	100 A	1,150	1,100	2,250
0280	200 A	1,875	1,700	3,575
0320	400 A	4,425	3,125	7,550
0360	600 A RD5010 -110	8,275	4,225	12,500
0400	800 A	10,200	5,100	15,300
0440	1000 A	12,400	5,850	18,250
0480	1200 A	15,800	6,000	21,800
0520	1600 A	27,800	8,600	36,400
0560	2000 A	30,600	9,800	40,400
0570	Add 25% for 277/480 volt			
0580				
0610	1 phase, 3 wire, 120/240 volts, 100 A	535	1,000	1,535
0620	200 A	1,100	1,475	2,575

D50 Electrical

D5020 Lighting and Branch Wiring



Duplex Receptacle

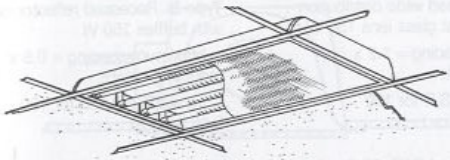
Wall Switch

System Components	QUANTITY	UNIT	COST PER EACH MAT.	INST.	TOTAL
SYSTEM D5020 125 0520					
RECEPTACLES AND WALL SWITCHES, RECEPTICLE DUPLEX 120 V GROUNDED, 15 A					
Electric metallic tubing conduit, (EMT), 3/4" diam	22.000	L.F.	24.20	100.76	124.96
Wire, 600 volt, type THWN-THHN, copper, solid #12	.630	C.L.F.	8.28	34.02	42.30
Steel outlet box 4" square	1.000	Ea.	2.73	30	32.73
Steel outlet box, 4" square, plaster rings	1.000	Ea.	3.70	9.30	13
Receptacle, duplex, 120 volt grounded, 15 amp	1.000	Ea.	1.51	14.90	16.41
Wall plate, 1 gang, brown plastic	1.000	Ea.	.43	7.45	7.88
TOTAL			40.85	196.43	237.28

D5020 125	Receptacles & Switches by Each	COST PER EACH MAT.	INST.	TOTAL
0460	Receptacles & Switches, with box, plate, 3/4" EMT conduit & wire			
0520	Receptacle duplex 120 V grounded, 15 A	41	196	237
0560	20 A	51	204	255
0600	Receptacle duplex ground fault interrupting, 15 A	79	204	283
0640	20 A	81.50	204	285.50
0680	Toggle switch single, 15 A	45	196	241
0720	20 A	47.50	204	251.50
0760	3 way switch, 15 A	48	208	256
0800	20 A	49	215	264
0840	4 way switch, 15 A	68	221	289
0880	20 A	84	236	320

D50 Electrical

D5020 Lighting and Branch Wiring



Type C. Recessed, mounted on grid ceiling suspension system, 2' x 4', four 40 watt lamps, acrylic prismatic diffusers.

5.3 watts per S.F. for 100 footcandles.

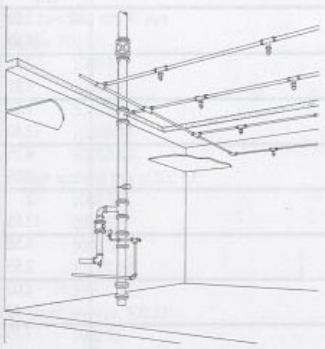
3 watts per S.F. for 57 footcandles.

System Components	QUANTITY	UNIT	COST PER S.F. MAT.	INST.	TOTAL
SYSTEM D5020 210 0200					
FLUORESCENT FIXTURES RECESS MOUNTED IN CEILING					
1 WATT PER S.F., 20 FC, 5 FIXTURES PER 1000 S.F.					
Steel intermediate conduit, (IMC) 1/2" diam.	.128	L.F.	.24	.76	1
Wire, 600 volt, type THW, copper, solid, #12	.003	C.L.F.	.04	.16	.20
Fluorescent fixture, recessed, 2'x 4', four 40W, w/ lens, for grid ceiling	.005	Ea.	.37	.64	1.01
Steel outlet box 4" square	.005	Ea.	.10	.15	.25
Fixture whip, Greenfield w/#12 THHN wire	.005	Ea.	.04	.04	.08
TOTAL			.79	1.75	2.54

D5020 210	Fluorescent Fixtures (by Wattage)		COST PER S.F. MAT.	INST.	TOTAL
0190	Fluorescent fixtures recess mounted in ceiling				
0195	T12, standard 40 watt lamps				
0200	1 watt per S.F., 20 FC, 5 fixtures @40 watts per 1000 S.F.	RD5020 -200	.79	1.75	2.54
0240	2 watt per S.F., 40 FC, 10 fixtures @40 watt per 1000 S.F.		1.59	3.43	5.02
0280	3 watt per S.F., 60 FC, 15 fixtures @40 watt per 1000 S.F		2.37	5.20	7.57
0320	4 watt per S.F., 80 FC, 20 fixtures @40 watt per 1000 S.F.		3.15	6.90	10.05
0400	5 watt per S.F., 100 FC, 25 fixtures @40 watt per 1000 S.F.		3.95	8.65	12.60
0450	T8, energy saver 32 watt lamps				
0500	0.8 watt per S.F., 20 FC, 5 fixtures @32 watt per 1000 S.F.		.85	1.75	2.60
0520	1.6 watt per S.F., 40 FC, 10 fixtures @32 watt per 1000 S.F.		1.71	3.43	5.14
0540	2.4 watt per S.F., 60 FC, 15 fixtures @ 32 watt per 1000 S.F		2.56	5.20	7.76
0560	3.2 watt per S.F., 80 FC, 20 fixtures @32 watt per 1000 S.F.		3.40	6.90	10.30
0580	4 watt per S.F., 100 FC, 25 fixtures @32 watt per 1000 S.F.		4.26	8.65	12.91

D40 Fire Protection

D4010 Sprinklers



Wet Pipe System. A system employing automatic sprinklers attached to a piping system containing water and connected to a water supply so that water discharges immediately from sprinklers opened by heat from a fire.

All areas are assumed to be open.

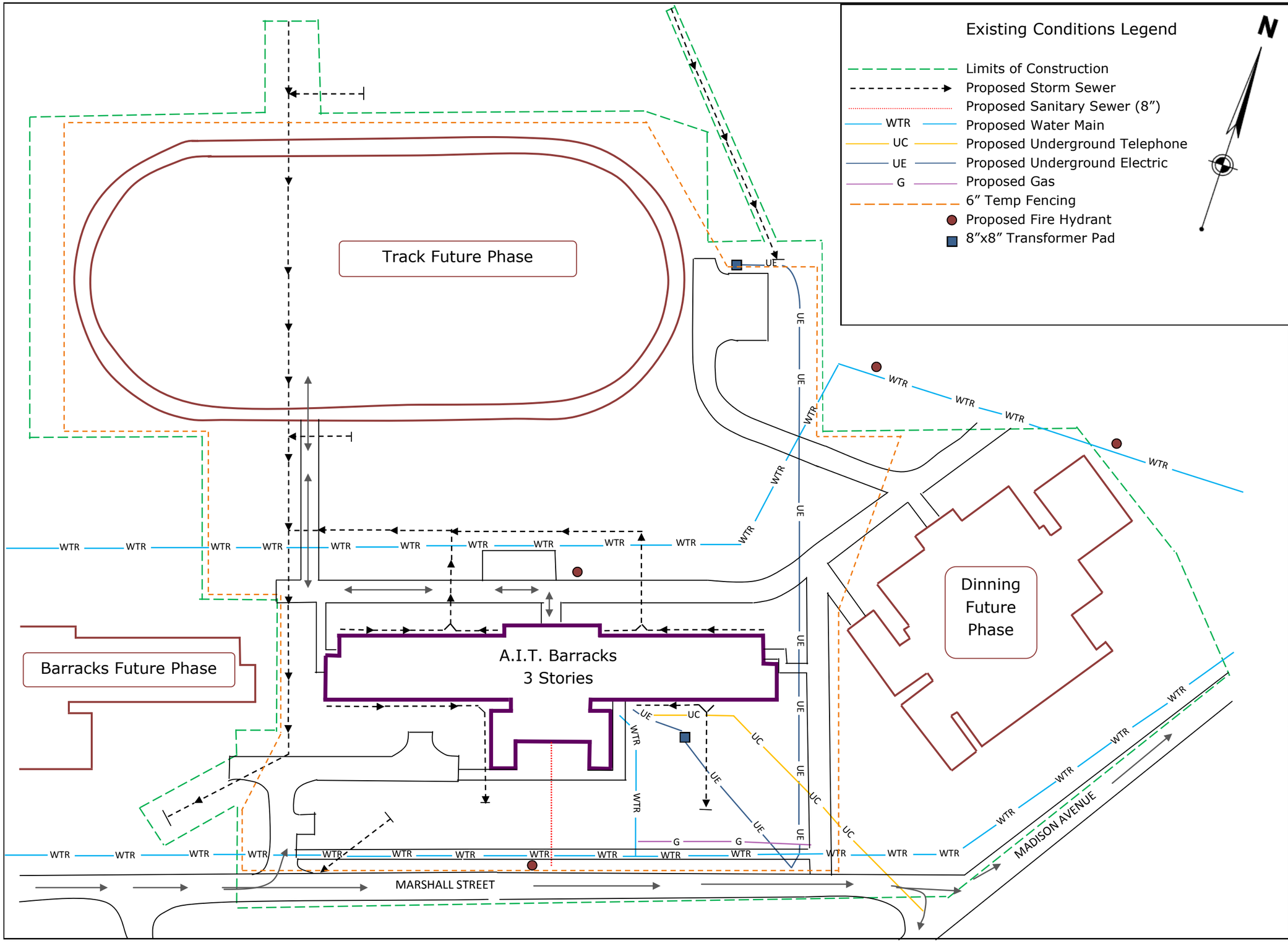
System Components	QUANTITY	UNIT	COST EACH MAT.	COST EACH INST.	COST EACH TOTAL
SYSTEM D4010 410 0580					
WET PIPE SPRINKLER, STEEL, BLACK, SCH. 40 PIPE					
LIGHT HAZARD, ONE FLOOR, 2000 S.F.					
Valve, gate, iron body, 125 lb., OS&Y, flanged, 4" diam.	1.000	Ea.	465	288.75	753.75
Valve, swing check, bronze, 125 lb, regrinding disc, 2-1/2" pipe size	1.000	Ea.	472.50	57.75	530.25
Valve, angle, bronze, 150 lb., rising stem, threaded, 2" diam.	1.000	Ea.	446.25	43.50	489.75
*Alarm valve, 2-1/2" pipe size	1.000	Ea.	1,068.75	285	1,353.75
Alarm, water motor, complete with gong	1.000	Ea.	266.25	119.25	385.50
Valve, swing check, w/balldrip CI with brass trim 4" pipe size	1.000	Ea.	222.75	285	507.75
Pipe, steel, black, schedule 40, 4" diam.	10.000	L.F.	130.13	239.70	369.83
*Flow control valve, trim & gauges, 4" pipe size	1.000	Set	3,731.25	648.75	4,380
Fire alarm horn, electric	1.000	Ea.	48.38	66.75	115.13
Pipe, steel, black, schedule 40, threaded, cplg & hngr 10' OC, 2-1/2" diam.	20.000	L.F.	285	345	630
Pipe, steel, black, schedule 40, threaded, cplg & hngr 10' OC, 2" diam.	12.500	L.F.	118.13	168.75	286.88
Pipe, steel, black, schedule 40, threaded, cplg & hngr 10' OC, 1-1/4" diam.	37.500	L.F.	233.44	364.22	597.66
Pipe steel, black, schedule 40, threaded cplg & hngr 10' OC, 1" diam.	112.000	L.F.	567	1,016.40	1,583.40
Pipe Tee, malleable iron black, 150 lb. threaded, 4" pipe size	2.000	Ea.	360	432	792
Pipe Tee, malleable iron black, 150 lb. threaded, 2-1/2" pipe size	2.000	Ea.	101.25	192	293.25
Pipe Tee, malleable iron black, 150 lb. threaded, 2" pipe size	1.000	Ea.	23.25	78.75	102
Pipe Tee, malleable iron black, 150 lb. threaded, 1-1/4" pipe size	5.000	Ea.	55.31	309.38	364.69
Pipe Tee, malleable iron black, 150 lb. threaded, 1" pipe size	4.000	Ea.	27.30	240	267.30
Pipe 90° elbow, malleable iron black, 150 lb. threaded, 1" pipe size	6.000	Ea.	38.03	220.50	258.53
Sprinkler head, standard spray, brass 135°-286°F 1/2" NPT, 3/8" orifice	12.000	Ea.	160.20	474	634.20
Valve, gate, bronze, NRS, class 150, threaded, 1" pipe size	1.000	Ea.	66.38	25.13	91.51
*Standpipe connection, wall, single, flush w/plug & chain 2-1/2"x2-1/2"	1.000	Ea.	101.25	171.75	273
TOTAL			8,987.80	6,072.33	15,060.13
COST PER S.F.			4.49	3.04	7.53

*Not included in systems under 2000 S.F.

D4010 410	Wet Pipe Sprinkler Systems		COST PER S.F. MAT.	COST PER S.F. INST.	COST PER S.F. TOTAL
0520	Wet pipe sprinkler systems, steel, black, sch. 40 pipe				
0530	Light hazard, one floor, 500 S.F.		2.57	2.90	5.47
0560	1000 S.F.	RD4010 -100	5.05	3.03	8.08
0580	2000 S.F.		4.50	3.04	7.54
0600	5000 S.F.	RD4020 -300	2.23	2.15	4.38
0620	10,000 S.F.		1.55	1.83	3.38
0640	50,000 S.F.		1.17	1.63	2.80
0660	Each additional floor, 500 S.F.		1.34	2.47	3.81

344

Appendix D
Existing Conditions Site Plan



Balfour Beatty Construction

WOOLPERT

A.I.T. Barracks
Marshall Street
Fort Eustis, VA

Submission Dates

9/23/2011

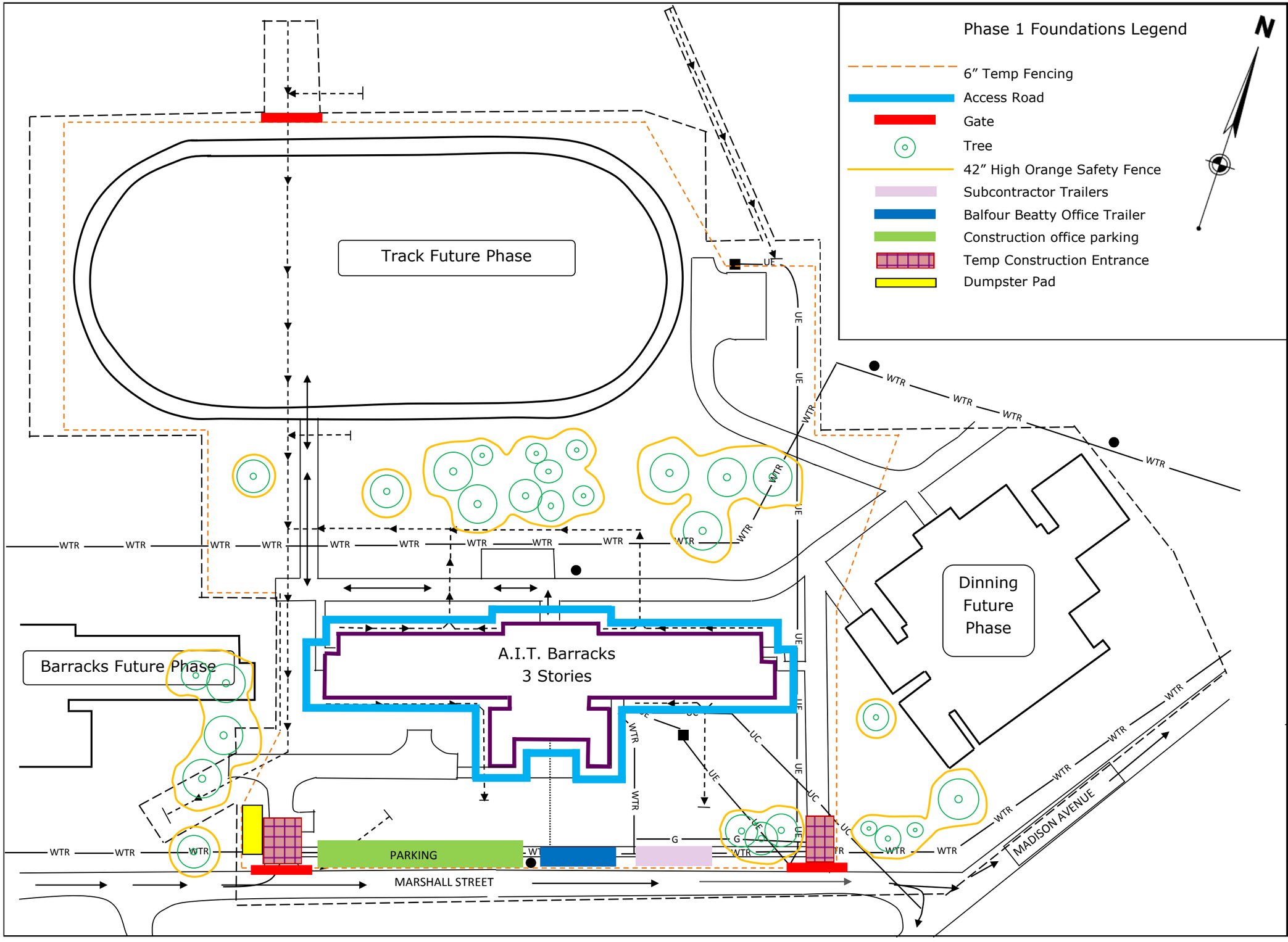
Sheet Title

Existing Conditions Site Plan

Sheet No.

EC101

Appendix E
Site Layout Planning Phases 1-3



Balfour Beatty Construction

WOOLPERT

A.I.T. Barracks
Marshall Street
Fort Eustis, VA

Submission Dates

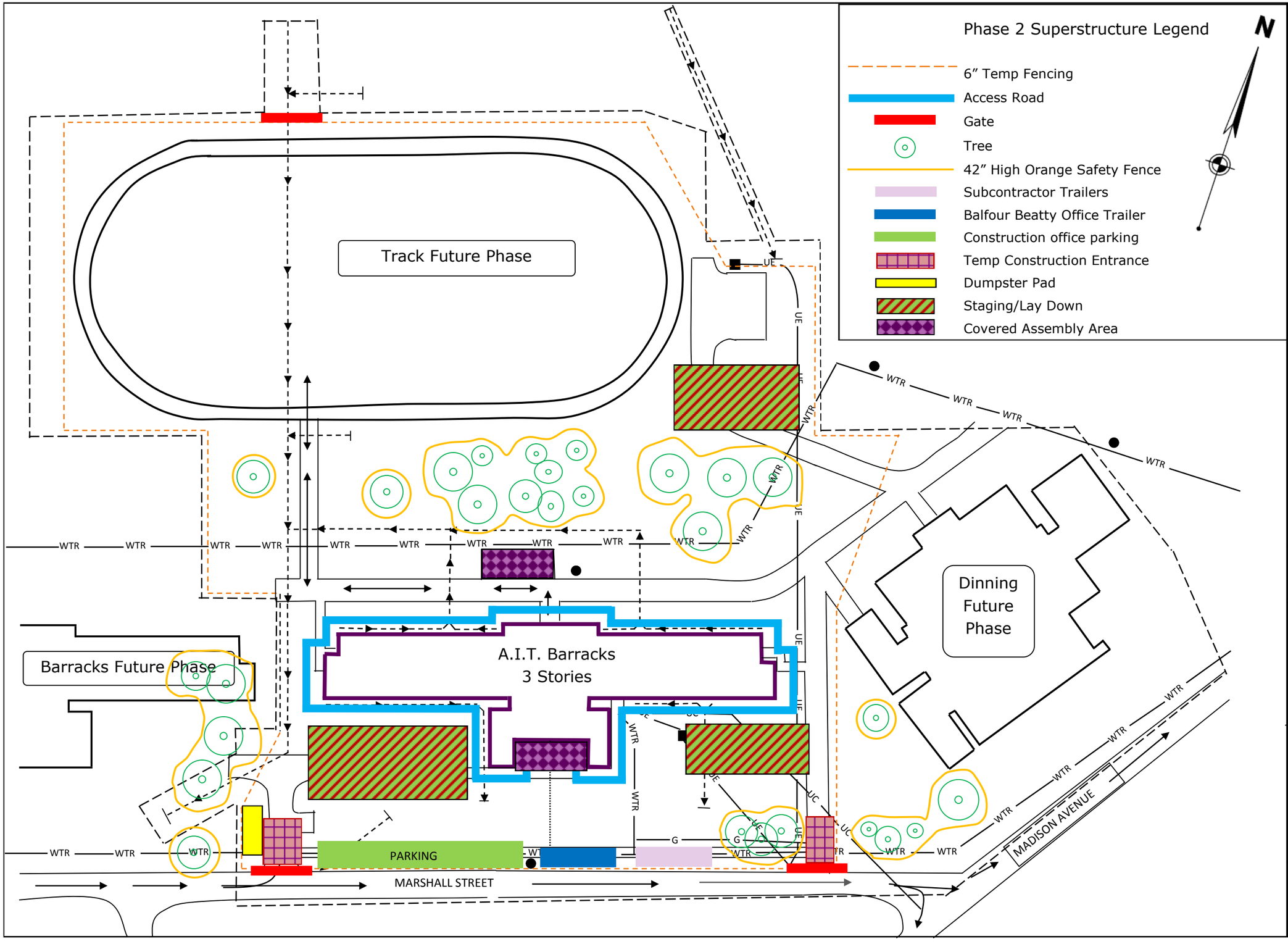
9/23/2011

Sheet Title

Site Plan
Phase 1

Sheet No.

SP101



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Fort Eustis, VA

Submission Dates

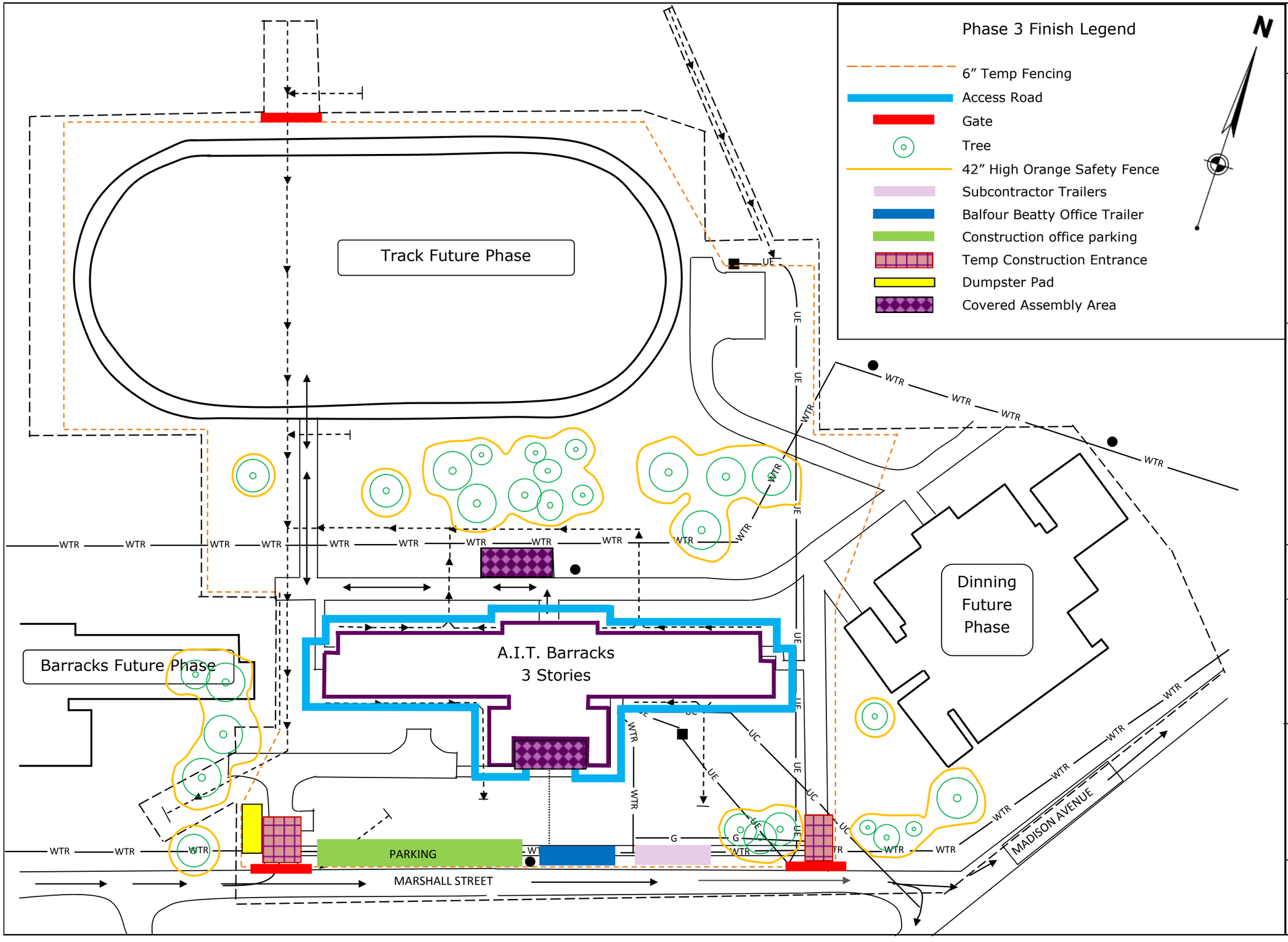
9/23/2011

Sheet Title

Site Plan
Phase 2

Sheet No.

SP102



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Sheet Title

Site Plan
Phase 3

Sheet No.

SP103